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ORO-R-I (FEC)

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ORO Regrading notice No. 59 - dtd 2 Oct 59
Pierre Peterson 12/18/59

REPORT

THE EMPLOYMENT OF ARMOR IN KOREA

VOLUME I

by

H. W. MacDONALD
E. D. STRONG
W. VanROYEN
I. J. BREEN
C. BILLINGSLEA
R. W. BRITTAIN
E. A. JOHNSON

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8 APRIL 1951

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G-3 052 Korea (20 Mar 52) 17 April 1952

SUBJECT: ORO-R-1 (FEC), "The Employment of Armor in Korea"

TO: Commandant
Army War College
Carlisle Barracks, Pennsylvania
ATTN: Col Hanecke

1. Transmitted herewith for your information is a copy of a Report by the Department of the Army Operations Research Office on the subject study.

2. In accordance with established procedures, the Office of the Assistant Chief of Staff, G-3 has evaluated ORO-R-1 (FEC). The evaluation contains the views of the Department of the Army on the recommendations contained in ORO-R-1 (FEC) and is attached as Incl. No. 1.

3. The subject publication is the result of studies conducted in the Far East Command. GHQ, FEC has reviewed the publication and submitted the comments which are attached to the inside of the front cover of the publication.

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/s/ REUBEN E. JENKINS

2 Incls:
1. Evaluation Ltr
2. ORO-R-1 (FEC)

REUBEN E. JENKINS
Major General, GS
Assistant Chief of Staff, G-3

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20 March 1952

SUBJECT: ORO-R-1 (FEC), "The Employment of Armor in Korea"

TO: Holders of Subject Report

1. This headquarters has received and reviewed comments from Army Field Forces and interested Department of the Army agencies on the Operations Research Office Report, ORO-R-1 (FEC), "The Employment of Armor in Korea" and considers that the report provides valuable reference material within the scope of its coverage. As pointed out in the note immediately preceding paragraph 1 on page 2 of Volume I, the "x x x conclusions x x x are derived primarily from the lessons and experience of the Korean compaign x x x ". This fact, as well as the fact that there existed a paucity of accurate information in certain fields, should be taken into account in order that the report may be properly evaluated.

2. The specific comments which follow apply to the conclusions and recommendations which are presented in numbered paragraphs on pages 2 to 5 of Volume I:

UNDER "CONCLUSIONS"

Paragraph 3 - Whether or not convoy escort and patrol duties put "uneconomical" mileage on tanks is dependent upon the situation. If viewed in the light of a grave situation, such employment of tanks may be relatively economical. The commander concerned must consider the factors involved at the time and make the necessary decision.

Paragraph 4 - The present table of equipment for an infantry division authorizes 135 medium tanks. This number is considered adequate.

Paragraph 5 - Current armor and infantry doctrine, which has been proved sound in combat, prescribes the organization of the tank - infantry team according to mission, terrain, etc. The infantry division is so organized as to permit the employment envisioned.

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SUBJECT: ORO-R-1 (FEC), "The Employment of Armor in Korea."

Paragraph 6 - Had enemy heavy armor been employed in Korea, the M-24 and the M4A3 would have been definitely outclassed. The M-26 and the M-46, with their armor and gun power superior to that of the M-24 and M4A3, would have appeared in a relatively more favorable light.

Paragraph 7 - The principal reasons for excessive logistic and maintenance problems associated with the M-26 and M-46 tanks were the relative inexperience of operating personnel, ineffective ordnance support, defects not yet corrected in the M-46, and the restricted road net.

Paragraph 13 - This conclusion should be considered with the knowledge that the number of Korean mines laid could not be accurately determined.

Paragraph 17 - With negligible exception, none of the tank and infantry units were able to train together prior to entering combat. Furthermore, communication equipment was old and in a poor state of repair, and no augmenting equipment was issued to meet the peculiar terrain conditions of Korea. The situation improved when more and longer range sets were used.

Paragraph 18 - The tank has an important role in the coordinated anti-tank plan and, as evidenced in paragraph 15 of the conclusions, is effective in that role. The light tank is best suited for convoy escort and is considered sufficiently satisfactory for this task that a special vehicle need not be developed for this sole purpose.

Paragraph 19 - Final evaluation of the effectiveness of tanks equipped with night vision devices cannot be made until development and field testing of such devices has been completed.

UNDER "RECOMMENDATIONS"

Paragraph 1c - The 105mm Howitzer mounted on the tank was used in World War II and, as a result of that experience, has been abandoned for the high velocity weapon. Self-propelled artillery has the capability of assuming the assault gun role.

Paragraph 1e - The mobile antiaircraft vehicles possess the stated characteristics, and development of a special vehicle for this sole purpose is considered undesirable.

SUBJECT: ORO-R-1 (FEC), "The Employment of Armor in Korea."

Paragraph 1f - Development at present is following two general lines. Infrared is being considered for use of commanders, gunners and drivers. Search light kits to provide direct lighting are being developed for installation on tank turrets.

Paragraph 1g - The following equipment is presently under development:

a. Tank mounted roller.

b. Radio controlled roller.

c. Mine clearing plow.

d. Jet mine clearing devices.

e. Tank mounted rotary hoe.

Paragraph 2b - The main effort in development of mines is toward those items that can be attained in the near future. This embraces development of a family of non-metallic, shaped charge, anti-tank mines with influence fuses, some of which will be suitable for use with a mechanical mine planter. Influence fuses employing two or more physical phenomena, such as vibration and magnetic fields, show great promise of enhancing inherent capabilities of shaped charge anti-tank mines. Long range development is toward those items less likely of attainment in the near future. Army Field Forces has submitted draft characteristics of aerial emplaced anti-personnel mines than can be emplaced by air drop, standard artillery, rockets, or mortars. Activity in this field is at present devoted to determination of feasibility. As rapidly as the more basic problems are solved, greater emphasis can be placed on what are at present the more visionary approaches to the problem.

Paragraph 2c - The following equipment is currently under development:

a. Metallic mine detector, AN/PRS-3.

b. Metallic and non-metallic mine detector, AN/PRS-4.

c. Tank mounted mine detector and eradicator.

d. Other detectors operating on different principles are

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SUBJECT: ORO-R-1 (FEC), "The Employment of Armor in Korea."

under development. Among these are detectors operating on acoustic principles, and on the variation in the earth's magnetic field caused by a mine.

Research is under way to determine new principles of mine detection which can be used for mines buried at depths beyond the capabilities of present mine detectors.

Paragraph 5 - Tanks are procured on the basis of requirements. The infantry division is allocated 135 medium tanks. (See comment on paragraph 4 under "CONCLUSIONS").

Paragraph 6 - There are no facts cited in the report to support this recommendation. The lightest tank that will do the job, is of course, desirable. Tests to date indicate that a medium tank that fulfills requirements will likely weigh in excess of 40 tons.

Paragraph 7 - It is considered that the production of tanks cannot be determined on an arbitrary proportional basis. Tanks must be produced after it is determined the type Army needed and appropriate tables of organization and equipment to man and equip that Army have been developed.

Paragraph 11 - Such training is conducted at the Service Schools, and Army Field Forces are currently studying ways and means toward its improvement.

Paragraph 12 - All "marginal utility" devices for tanks receive extensive Service testing before they are accepted as standard equipment. At any time thereafter, such devices are eliminated when it can be established that they are not contributing to the combat worthiness of the vehicle.

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/s/ REUBEN E. JENKINS

REUBEN E. JENKINS
Major General, GS
Assistant Chief of Staff, G-3

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AUTHORITY ORO Regarding notice no 59-2 dtd 20 Feb 59
BY Pearl Petersen, ON 11/13/59

AG 381 (10 Sep 51)GC-O 10 Sep 51

SUBJECT: Report on the Employment of Armor in Korea, ORO-R-1 (FEC)

TO: The Adjutant General
Department of the Army
Washington 25, D.C.
ATTENTION: Assistant Chief of Staff, G-4

1. Attached is report on above subject prepared by the Operations Research Office (ORO), Far East Command. Four (4) advance copies of the report were forwarded to Department of the Army without comment on 22 July 1951. One hundred and fifty (150) copies of subject report have been furnished Operations Research Office, Department of the Army, by the Operations Research Office, Far East Command. Four (4) advance information copies have been sent to the War Office, London, and two (2) advance information copies to the Defense Research Board, Canada, by the Operations Research Office, Far East Command. No other distribution has been made outside the Far East Command nor is any contemplated.

2. This report is published in two volumes and covers the period 1 July 1950 to 8 April 1951. This letter reviews Volume I and ORO staff Memorandum ORS/KOREA, Report No. 3, entitled "Periodic Armor Report" (8 April - 10 June 1951), which is a supplement to Volume I. Volume II is not included in this review since information contained therein is essentially supporting data for Volume I.

3. This report is a comprehensive and valuable analysis of the employment of armor in Korea. It should be of particular value to appropriate schools, boards, and other agencies concerned with the tactics, technique and logistical support of armor.

4. Copies of comments obtained from subordinate commands and staff sections of this headquarters have been furnished to the Director, Operations Research Office, Far East Command.

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AG 381 (10 Sep 51)GC-O, Subj: Report on the Employment of Armor in Korea, ORO-R-1 (FEC)

5. Specific comments on the conclusions and recommendations of the report are presented in Inclosure 1. An errata sheet to Volume I is attached herewith as Inclosure 2.

FOR THE COMMANDER-IN-CHIEF:

/s/ C. C. B. WARDEN

C. C. B. WARDEN
Colonel AGC
Adjutant General

4 Incls
1. Specific Comments - ORO-R-1 (FEC)
2. Errata Sheet - ORO-R-1 (FEC)
3. ORO-R-1 (FEC), Vol I, 8 Apr 51, Copy #173 w/ORS/Korea Report No. 3, 28 Jun 51, Copy #173
4. ORO-R-1 (FEC), Vol II, 8 Apr 51, Copy #23

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SPECIFIC COMMENTS — ORO-R-1 (FEC)

Following are specific comments by the Commander-in-Chief, Far East on the conclusions and recommendations of subject report, Volume I.

1. Para 4, page 2. The present tables of organization for an infantry division authorize 135 tanks. This is considered adequate.

2. Para 6, page 2. The relatively superior performance records of the M4A3 and M24 tanks were due to the fact that logistic and maintenance support teams were better trained to handle these types and replacement parts were available in greater quantities in comparison to the M46 and M26 types. The US Army has had far greater experience with the M4A3 and M24 tanks than with the M46 and M26.

3. Paras 7-8, page 2. Since this report, mechanical failures and maintenance problems have been materially reduced by the arrival of new equipment and by the additional experience gained by using units.

4. Para 11, page 3. Many units expressed an opinion that the figure 38% for casualties resulting from enemy mines was too conservative. It is considered that this figure at present is closer to 75%.

5. Para 14, page 3. Several units question the effectiveness of flails since many enemy mines are buried $2\frac{1}{2}$ feet or deeper. The mine exploder, TIE 3, is too cumbersome to operate on most of the roads in Korea.

6. Para 17, page 3. Improvement continues in communications as the result of battlefield experience, training, and the issue of additional radio sets which are capable of reliable operation over extended ranges.

7. Para 21, page 3. See comment #3 above.

8. Para 1e, page 4. It is understood that the development of a light armored vehicle embodying the principles outlined is in progress. This vehicle is known as the "Stinger" and mounts four caliber 60 machine guns in a turret designed for mounting in a modified T41 light tank chassis.

9. Para 1h, page 4. See comment #6 above.

10. Para 2b, page 4. Saturation of areas held by enemy forces with remote-laid anti-tank mines may be impractical in many situations because of the psychological and physical hazard to friendly troops should these areas be later reoccupied. Recommend continued research and analysis of the problem of remote lethal mines, capable of self-sterilization.

11. Para 5, page 5. See comment #1 above.

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OPERATIONS RESEARCH OFFICE REPORT

ORO-R-1 (FEC)
8 April 1951

THE EMPLOYMENT OF ARMOR IN KOREA

(in two volumes)

VOLUME I

by

H. W. MacDonald
E. D. Strong
W. Van Royen
I. J. Breen
C. Billingslea
R. W. Brittain
E. A. Johnson

Operations Research Office
General Headquarters
Far East Command

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FOREWORD

This report is the joint effort of the US Army Operations Research Office, The Johns Hopkins University (H. W. MacDonald, W. Van Royen, I. J. Breen, C. Billingslea, E. A. Johnson); and the Army Operational Research Group, UK (R. W. Brittain, E. D. Strong)--on temporary duty with the Operations Research Office, GHQ, Far East Command.

The report is in two volumes. Volume I contains all sections of the report except Appendix K. Volume II contains Appendix K.

The body of the report is largely concerned with Armor activity during the period 1 July 1950 to 21 January 1951. Activity between 21 January 1951 and 8 April 1951 is briefly discussed in Appendix L and in Annex 7 of Appendix I.

The writers wish to express their appreciation of the helpful cooperation and assistance rendered by Colonel William K. Withers (Armor Officer, US Eighth Army) and members of the Armored Units operating with the Eighth Army.

15 May 1951

GEORGE SHORTLEY
Director, ORO, FEC

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SUMMARY

PROBLEM

The problem is to evaluate the employment of armor in Korea, to draw conclusions therefrom, and to recommend logistic action to improve the effectiveness of armor.

FACTS

The terrain and roadnet of Korea precluded the employment of tanks in the manner of the armies which operated in western Europe and North Africa.

Light M24 tanks were the only armor available for commitment to combat at the outbreak of the Korean campaign.

The medium tank units sent to reinforce our armor arrived and entered combat in August 1950, equipped with M4A3, M26, and M46 tanks. British Centurion, Churchill, and Cromwell tanks arrived in November 1950.

DISCUSSION

This report is a summary of the material and information gathered by several ORO groups working in Japan and Korea on the employment of both enemy and friendly armor in the period July 1950 to January 1951. The tactical employment of tanks as imposed by the terrain and the enemy is reviewed and tabulations of tank casualties by cause and types have been prepared. Data are not complete in all cases, particularly in the case of enemy tank casualties. The various weapons and circumstances which caused tank casualties are analyzed and discussed.

Other factors influencing the employment of tanks in Korea, including terrain and trafficability, tank-infantry teamwork and communications, cold weather operation and maintenance, and logistic support are also part of this discussion. In addition, sections have been devoted to recommendations and suggestions from personnel of armored units and on the suitability of the various types of tanks actually employed in Korea for this type of service. A brief study on the economies of the use of the M46 tanks as compared with the new medium tank T42 has been made.

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Since the number of British tanks committed was few in comparison with the number of US tanks, the conclusions and recommendations of this report are largely based on experience with US tanks.

CONCLUSIONS

Note: The conclusions made herein are derived primarily from the lessons and experience of the Korean campaign. In a military operation of a different character, certain of these conclusions may not be applicable or may have to be materially modified or altered.

1. UN tanks have been usefully and effectively employed in the Korean operation.

2. The terrain encountered in Korea limited the mass employment of tanks on a wide front as was common in Europe and Africa.

3. While terrain has denied the fullest use of armor, armor has been sufficiently versatile to serve in many different capacities. Some of these, such as convoy escort and patrol duties, have put heavy and uneconomical mileages on the tanks.

4. On the basis of Korean experience, some 150 tanks can be usefully employed by each infantry division, even in mountainous terrain.

5. The use and number of assigned tanks should be flexible depending on the team mission. The number may vary from a tank platoon per infantry company when the capture of a limited objective against normal opposition is involved, to one tank company per infantry company when the capture of a distant objective against heavy opposition is involved.

6. On the basis of their over-all performance and casualty rates, and considering their advanced state of mechanical development, the M4A3 and M24 tanks were best suited for use in Korea.

7. Medium tanks (i.e., M46's and M26's), while admittedly very powerful and effective weapons, were a very serious logistic and maintenance problem in Korea.

8. Mechanical failures among all types of tanks in Korea were extremely high.

9. On the basis of limited evidence, air attack accounted for 40 percent of all enemy tank losses in Korea, and 60 percent of all enemy tank losses caused by UN weapons.

10. On the basis of limited evidence, napalm was the most effective antitank air weapon thus far used in Korea.

SUMMARY

11. NK mines caused 38 percent of US tank casualties arising from direct enemy action. Few of these casualties were total losses because of the low lethal effect of the mines.

12. NK mine fields were laid in no predictable pattern over many miles of road, often without covering fire.

13. The NK exchange rate was better than one US tank casualty for every 100 antitank mines laid.

14. Tanks equipped with flails or some other type of antitank mine destroyer would have been useful in clearing mines and reducing tank casualties.

15. US armor was second to air in killing enemy T34 tanks. POW information indicates that kills were generally obtained on the first round, and that there were few survivors among enemy tanks penetrated by US tank fire.

16. On the basis of the record, only a relatively small number of tanks was destroyed by bazookas.

17. Communications between tanks and infantry, and tanks and battalion headquarters, have been unsatisfactory through lack of training, inadequate equipment, and terrain.

18. The use of tanks as more or less fixed infantry antitank weapons or as convoy escorts is an expensive practice. Cheaper and more suitable weapons should be available for this purpose.

19. Tanks can be effectively employed at night if night vision devices are provided, and prior training in night operations with infantry is carried out. Night tank operations are necessarily restricted in scope and area.

20. The use of standard issue winter clothing by tank crews is impractical.

21. The logistic and maintenance support of tanks has been very inadequate.

22. Light aircraft operating with tank battalions have been invaluable for reconnaissance and maintaining communications when the companies have been spread over wide fronts.

23. On the basis of the burning of the rubber on tank road wheels with napalm, resulting in the destruction of the tank, tanks appear vulnerable to 40-KT atomic-weapons attack up to a distance of 2,500 yards on a clear day, and 2,000 yards on a hazy day.*

* See ORO-R-2 (FEC), Appendix A, for discussion.

RECOMMENDATIONS

Research and Development

1. Support a vigorous and extended research and development program to improve tank design, including emphasis on:

a. Improvement of mechanical simplicity and reliability of tanks, with special attention to interchangeability of parts and ease of maintenance.

b. Reduction of fuel consumption, by keeping weight to the minimum consistent with armor protection requirements, and by more effective utilization of power.

c. The use of an infantry support gun such as the 105-mm howitzer in one version of the medium tank.

d. Continued over-all improvement of the mobility and agility of UN tanks, including improvement of track design.

e. A lightly armored highly mobile vehicle equipped with multiple automatic weapons of not less than cal .50 and not more than 40 mm, capable of delivering 360° fire against both air and ground targets, should be developed as an escort for motor convoys.

f. Provision of a night-vision device which will enable tanks to negotiate terrain and observe the movements of enemy infantry or tanks in darkness.

g. Provision of equipment for mounting on tanks as needed for the clearing and destruction of mine fields.

h. Development of a more effective type of long-range radio for tanks operating in hilly terrain.

2. Support a vigorous and expanded research and development program to provide a balanced family of antitank weapons without, however, either overemphasizing or neglecting the role of heavy gun tanks such as the US T43. This program should emphasize:

a. Development of an effective long-range antitank gun for use by the infantry. This gun should be capable of being moved over rough and unfavorable terrain, preferably in a light, highly mobile vehicle.

b. Development of a family of lethal, influence-fused antitank mines, with sterilizing and arming devices, suitable for remining by rockets, artillery, and air.

c. Simultaneous development of corresponding mine-detection and clearing devices.

SUMMARY

d. Research and development on new types of air and ground munitions utilizing liquid fillers, such as napalm, chlorine trifluoride, pronock, and G-agents.

e. Continued development of special ammunition, such as shaped-charge and squash-head ammunition, together with improved bazookas and recoilless rifles.

Tactics

3. Develop tactics and techniques for statistical laying of lethal antitank mines.

4. Improve the quality of communications between tanks and infantry by improvement of equipment and training.

Logistics

5. Procure medium tanks at a rate that will provide about 150 tanks for each infantry division. This should be in addition to the requirements for armored divisions.

6. Choose a medium 35 ton tank for present US production in order to take advantage of its lower logistical support requirements and, as compared to the M46, its 30 percent saving in steel.

7. Produce T41 and T43 tanks at a ratio of about one-tenth each of medium tank production.

8. Strengthen normal maintenance and logistic support to armored units, particularly on divisional and forward support levels.

9. If armor is to be used in a terrain comparable to Korea, provide extra logistic and maintenance support.

10. Issue winter clothing that can be comfortably and conveniently worn inside a tank.

Training

11. Stress joint training at all levels at both infantry and armor schools, emphasizing to each branch the capabilities and limitations of each member in the infantry-armor-air artillery team.

General

12. Give consideration to elimination of all devices of marginal utility in tanks, including:

a. Gyro-stabilizers.
b. Range finders.
c. Cant correctors.

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THE EMPLOYMENT OF ARMOR IN KOREA

PROBLEM

The problem is to evaluate the employment of armor in Korea, to draw conclusions therefrom, and to recommend logistic action to improve the effectiveness of armor.

FACTS

The terrain and roadnet of Korea precluded the employment of tanks in the manner of the armies which operated in western Europe and North Africa.

Light M24 tanks were the only armor available for commitment to combat at the outbreak of the Korean campaign.

The medium tank units sent to reinforce our armor arrived and entered combat in August 1950, equipped with M4A3, M26, and M46 tanks. British Centurion, Churchill, and Cromwell tanks arrived in November 1950.

DISCUSSION

Tactical Employment of Friendly Armor

The opinion held by many in military circles prior to the attack by the North Koreans, that the terrain of Korea precluded the use of tanks, was correct in the manner in which they were probably thinking. The employment of armor in great force to destroy and scatter the enemy, in the style of the German army in the USSR, the opposing forces in North Africa, or the Allies in western Europe, was definitely denied by the terrain and roadnet. However, as the North Korean army demonstrated, the tank can be profitably employed even under the conditions imposed by the geography of the country.

At the beginning of the Korean campaign, our capacity to engage in tank warfare was as limited proportionately as other elements of the US army then available in the Far East. The first tanks committed to action were M24 light tanks which had seen long service in Japan. These tanks, assigned to divisional tank battalions that should have been equipped with medium armor,

UN Tanks used in Korea. Upper: US M4A3. Lower: US M26.

TACTICAL EMPLOYMENT OF FRIENDLY ARMOR

UN Tanks used in Korea. Upper: US M46. Lower: British Centurion.

CHARACTERISTICS

GUN : 85 MM(M-1944)
PENETRATION
(1000 YDS-30° : 4.1"
WEIGHT : 35 TONS
W/TITANIUM : --
ARMOR:
FRONT : 1.8" AT 60°
TURRET : 3" AT 20°

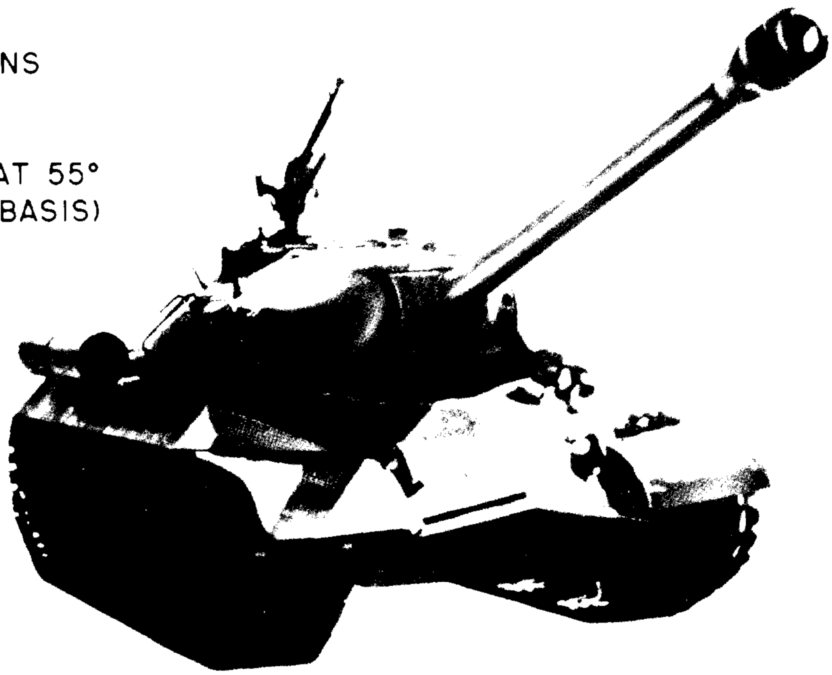
DISCUSSION

T-34

CHARACTERISTICS

GUN : 122 MM (D-25)
PENETRATION
(1000 YDS -30°) : 6.5"
WEIGHT : 51 TONS
W/TITANIUM : --
ARMOR:
FRONT : 4.7" AT 55°
TURRET : 7.9" (BASIS)

JS-III

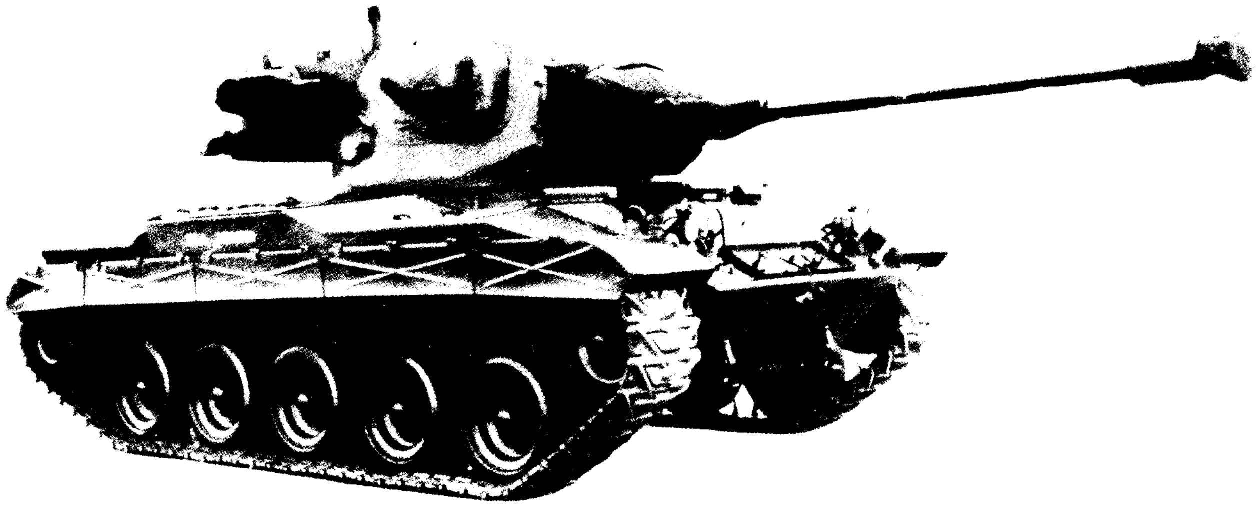


Soviet Tanks. Upper: T34, used in Korea. Lower: JS-III.

T-41

CHARACTERISTICS

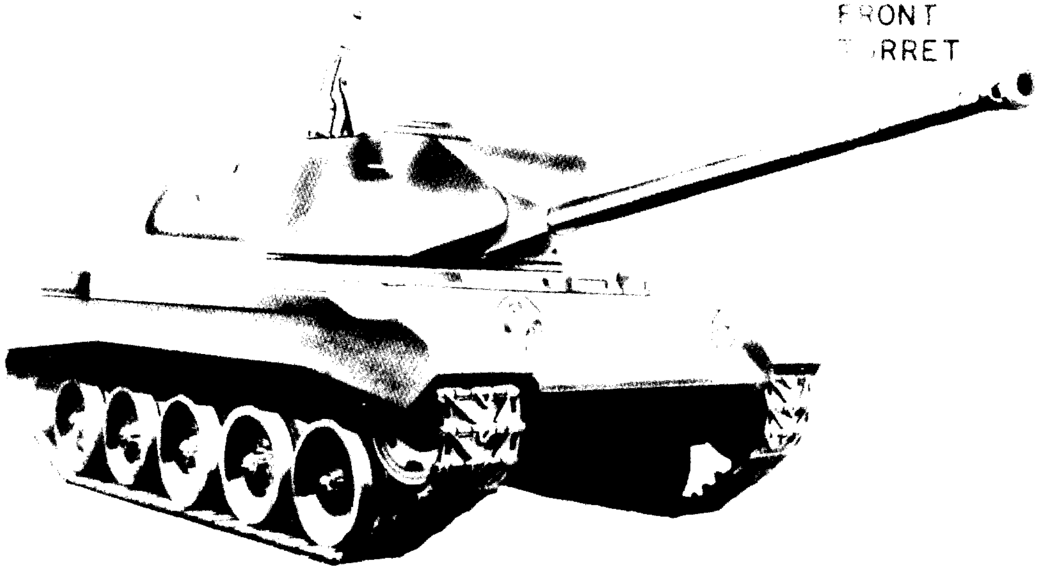
GUN	: 76 MM (T-91)
PENETRATION	
(1000 YDS - 30°	: 4.8"
WEIGHT	: 25 TONS
W/TITANIUM	: 21 TONS
ARMOR	
FRONT	: 1" AT 45°
TURRET	: 1 1/4" AT 56°



T-42

CHARACTERISTICS

GUN	: 90 MM (T-119)
PENETRATION	
(1000 YDS - 30°	: 6"
WEIGHT	: 36 TONS
W/TITANIUM	: 31 TONS
ARMOR	
FRONT	: 4" AT 60°
TURRET	: 4" AT 40°



US proposed Tanks. Upper: US T41. Lower: US T42.

were easily overcome by the enemy's heavier and numerically superior T34 tanks which they were attempting to combat. Our M24 losses, from both battle casualties and mechanical failures, during the first phases of our troop build-up in Korea were extremely heavy in proportion to their numbers.

In August, the first medium tank battalions equipped with M4A3's, M26's, and M46's plus a few M45's, a version of the M26 armed with a 105-mm howitzer, reached Korea and entered combat. The commitment of these tanks was one of the decisive factors in turning the tide of battle. The M4A3's were on better than even terms with the enemy tanks and the M26 and M46 were unquestionably superior in combat. UN medium tanks have dominated the tank warfare picture from the time of their first commitment.

In the first six months of the Korean campaign, three distinct types of operations, involving the employment of tanks, have occurred. The first, beginning in early July when the enemy was first encountered, was our effort to stem the North Korean advance toward the Pusan perimeter. The second was our forward movement across the Naktong to link up with the Inchon landing and the combined advance beyond the 38th parallel toward the Yalu River. The final operation was our gradual retirement from our forward positions to a defense line south of the 38th parallel. For the purposes of the discussion which follows, these phases will be described as "Holding Action," "Breakout and Advance," and "Withdrawal."

Holding Action. During our retirement to the Pusan perimeter, our tanks were largely employed as direct-laying artillery: they supplied a powerful but expensive antitank gun able to stand up and expose itself to fire and to combat enemy armor at ranges beyond that which the infantry bazooka could be effective; they served also as an accompanying gun to be used as required against enemy roadblocks, fortified positions, and infantry. The tank found further employment as the spearhead of local counterattack operations against enemy penetrations, and as cover for the flanks of our thinly deployed and dangerously exposed infantry. Despite heavy losses in armor from air attacks and serious interdiction of his lines of communication, the enemy was still able to muster a considerable force of tanks at the point of his farthest advance. The defeat of this force was not accomplished until our medium tanks were able to relieve the light tanks which had been committed earlier.

Breakout and Advance. With the breakout from the perimeter and the landing of the X Corps at Inchon, 15 September, the second phase of armor employment began. This phase consisted of overcoming strong points, pursuing the retreating enemy, and destroying him in detail. Here, for the first time, appeared some semblance of the traditional type of armored warfare. In

the form of small task forces organized around a tank unit, usually of company size, armor made long strikes into the enemy areas with considerable success (see Appendix C). These operations extended from the Naktong River up to the positions of the Eighth Army north of Pyongyang, prior to the attack of the Chinese Communist Forces about 24 November. The existence of any appreciable armor in the possession of the enemy ended here.

On the other hand, the X Corps, withdrawing from the Inchon-Seoul area and landing again at Wonsan, employed their tanks on extensive reconnaissance work, as infantry-support weapons, and as divisional and corps reserves in their operations to the north and northeast of Wonsan. Little or no enemy armor was encountered during this period and tank units moved up to the Yalu River at Hysanjin and around the Chosin Reservoir (see Appendix B).

Withdrawal. The third phase in Korea was the withdrawal of the UN forces before the advance of the Chinese. The tasks for tanks in this operation were multitudinous, and included the clearing of road blocks on routes of withdrawal, covering the rear guard, and guarding regimental command posts and supply lines against attacks from infiltrating enemy forces. Tanks also acted as escorts for convoys proceeding through hostile areas. The tanks, interspersed among other vehicles, would pin down by their fire enemy forces attacking the convoy with machine guns and mortars on the bordering high ground. Perhaps the widest and most successful use of tanks was as road blocks covering nodal points of communication during the withdrawal of the general force. The enemy was greatly deterred by these actions, seeming to hold the armored fire in profound respect. Tanks were also used to move along with the infantry column, to give it greater defensive strength with their fire and metal. Several of these operations came off badly because of insufficient control over the fire and movement of the armor (see Appendix E).

This phase was marked by extremely aggressive enemy infantry action. There are a number of instances reported of infantry attacking tanks at close range when tanks found themselves cut off or deserted by our own supporting forces. If two or more tanks were present to provide mutual support, these enemy actions were seldom successful and were usually very costly. The tactics employed against the tanks called first for a heavy concentration of small arms fire on the tank to attempt to knock out periscopes, radio antennas, and external automatic weapons, and thus blind the crew and prevent them from effectively fighting their vehicle. Close-in attacks were then made to damage the tanks with pole or satchel charges and grenades. CCF climbed on the tank and tried to toss grenades through the hatch.

These attacks, particularly in the X Corps area of operations in northeast Korea, were usually made at night. Because of the ineffectiveness of the CCF weapons, the covering fire

from other nearby tanks defeated the enemy in nearly all known instances of this kind. It may also be said that when the presence of our tanks was known to the enemy in advance, he generally showed a marked reluctance to press an attack. When some light--either from moonlight, gasoline fires, or from burning villages--illuminated the enemy, our tanks destroyed them in great numbers, if sufficient supplies of HE and WP ammunition were available. As the effectiveness of the night operations of our tanks was entirely dependent upon some external light sources, it is clear that a night-vision device in tanks should be provided as soon as possible if tanks are to be employed against an enemy operating extensively at night.

Tank-Infantry Task Forces. The ability of armor to exploit a breakthrough was illustrated by the 172-mile drive of Task Force Lynch from Taegu to Suwon in 48 hours to link up with the 7th Division moving inland from the Inchon beachhead, and the drive of Task Force Dolvin from Chinju to Nonsan, a distance of 150 miles, between 25-30 September. Such operations were frequent during the period following the breakout from the Naktong line and the subsequent advance up the peninsula, and generally involved one or two companies of tanks, each operating in conjunction with a company of infantry, with mortar, signal, medical, and engineer detachments, and with a TACP to call in air strikes. From the experience obtained during these operations, there emerged the plan for the fully integrated tank-infantry teams which played a large part in the advance of the UN forces from their positions around Suwon up to the Han River in February.

OPERATION PUNCH involving elements of the 25th Division and the 64th and 89th Tank Battalions, is described fully elsewhere (see Appendix G). At the beginning of the operation the enemy held the dominant ground between Suwon and the Han River, an east-west hill mass about 10 miles north of the city, of which hills 440 and 431 were dominant features. From these heights, one could look northward across a series of subordinate ridges flanking the Anchunchon River which ran almost due north to the Han. Leading north from Suwon were two roads: one, the MSR of I Corps, ran via Anyang-ni to the Han River and thence to Seoul; the other, 6,000 yards to the westward, wound through the lower slopes of hill country. The general concept was that with the capture of hills 440 and 431 by direct infantry assault, and before the CCF and NK could effect a general withdrawal, the infantry-armor columns would attack northward along the two highways, hitting the enemy along the flanking ridges and inflicting as many casualties as possible. The task forces organized in anticipation of the situation were:

1. TF Bartlett, comprising the 64th Tk Bn, less Co C; 2nd Bn, 27th Inf, with mortar platoon and one platoon of quad .50's; platoon of Co A, 65th Eng Bn; Medical and Signal Detachments, 25th Div; and organic TACP.

2. TF Dolvin, comprising the 89th Tank Battalion, less Co's A, C, and D; Co C, 64th Tank Battalion; 1st Battalion, 27th Infantry with mortar platoon and one platoon of quad .50's; platoon of Company A, 65th Engineer Battalion; Medical and Signal Detachments, 25th Division; TACP of the 27th Infantry Regiment.

Concurrently with the final assault on hill mass 431-440, the armored sweep began its enveloping run on both flanks. On 5 February both task forces attacked north and gained their objectives, then prior to darkness withdrew to blocking positions along the MLR. This became the pattern of **OPERATION PUNCH** during the next few days. The task forces, despite persistent mining of the roads, especially in defiles, operated with relative impunity for the greater part of a week. Each day they pushed forward ahead of the main infantry force, engaged the enemy between the two roads, and withdrew to their assembly areas by nightfall, leaving the enemy to try and rebuild along the flanks of the two highways. In this way the enemy was enticed into a trap and probably lost more men than would have been the case if the armored columns had made a rapid envelopment. When the country was cleared of enemy, 4,250 enemy dead were counted south of the Han River, mostly along the route of the armored sweeps of **OPERATION PUNCH**; the task force casualties were trifling.

During this action, the following principles were adopted and resulted in harmony and efficiency in the operation.

1. Infantry and armored staffs were completely integrated.

2. Each tank company was teamed with an infantry company.

3. Infantry and tank platoon commanders rode together in the same tank.

4. The halt, fire, and deployment were done on the order of the infantry company commander. Although the task force was set up as an armored force reinforced by infantry under the command of the tank battalion commander, the two battalion commanders agreed that this was the practical method.

5. The TAC and artillery FO's rode with the TF commander.

6. While the TF was mounted up, the tank communications system was used throughout.

7. Upon engagement opening, the fire of the quad .50's was controlled by the TF commander through normal tank channels.

The tactics used were as follows:

1. The armor did not fire while the infantry was mounted.

2. The two infantry platoons which were to be first in the assault were mounted up front; they were in fact tactically disposed while riding the tanks.

3. When fire came against the column, it halted immediately and the infantry was deployed.

4. In the absence of fire, the armor rode the infantry as far as possible into the position to be taken under attack.

5. "As far as possible" was in this instance taken to mean within effective small arms range of such enemy as might be holding the position. At that point the force was deployed irrespective of the fire situation.

6. The platoon of quad .50's was split into two sections of three tracks each; they were used with the lead companies, leaving none in reserve.

7. When any enemy force was located, it was engaged with all guns by the armor and by the quad .50's once the infantry had dismounted and was ready.

8. Air strikes and field artillery fire were called for at every opportunity.

9. The combined metal barraged all ground that the infantry assault line was preparing to take under attack.

As the infantry line started to assault a hill, the vehicular fire was generally shifted to the crest and the artillery fire was lifted to ridges and escape routes. At that point, fire control passed into the hands of the infantry commander who was moving up with his artillery FO; the former thereafter directly controlled the fire from armor and quads until the hill was taken. Commonly, one man moving in the lead of each infantry platoon wore a red panel on his back. This enabled the tanks to follow visually the advance of the infantry, and to shift fire into the heart of any strong points encountered. The quad .50's proved very effective support weapons in this type of operation, but require modification to suit them for a dual air-ground role.

The success of this operation shows what can be achieved by a fully integrated tank-infantry team. Both tank and infantry commanders attributed its success to the merging of the two staffs, causing them to act not as tankers and infantrymen but as men confronted with a single problem.

<u>Tanks Employed as Convoy Escorts</u>. The use of tanks as escorts for motor convoys, although unavoidable in Korea, is an uneconomical practice which creates a heavy maintenance problem

because of the high mileage that the tanks build up when on convoy duty. Also, such use deprives the combat forces of tank support when it may be greatly needed. Tanks interspersed in a convoy and halted in place to fire tend to block the vehicles behind them and expose these vehicles to a greater concentration of fire. The Korean experience indicates that most of the difficulties encountered by attacks on convoys along the supply routes were caused by relatively small and lightly armed forces which infiltrated to our rear. It would seem, therefore, that a cheaper armored vehicle, equipped with automatic weapons capable of delivering instantaneous fire and with good visibility for the crew, would be a more practical type of convoy escort for defense against both air and ground attacks. The motor carriages equipped with twin 40-mm Bofors or quad-mounted cal .50 machine guns suggests the type. Such a vehicle, however, to be effective, must have a high degree of mobility permitting it to move rapidly off the road, around or away from the convoy as the situation may demand.

Employment of Light Tanks. Light tanks were discredited rather early in the Korean operation because of the poor mechanical condition of those first employed, and their inherent inability to cope with heavier tanks having thicker armor and more powerful guns. However, the few reconnaissance units that retain M24's express great confidence in this tank when it is used on its proper mission of reconnaissance or in combat with lightly armed forces (see Appendix B). In northeast Korea, where medium tanks were employed in very difficult mountainous terrain and suffered, as a consequence, considerable losses because of mechanical failure and terrain difficulties, light tanks could have been very effective in fighting the Chinese infantry who had no armor support.

Tank Fire Power and Gunnery. Because of the restrictions imposed by terrain, tank versus tank engagements usually involved small groups, with the lead tanks in column on the roads playing the major role. Consequently, many tank fights were meeting engagements with the opposing tanks presenting their front slopes to fire (see Appendix K).

With the exception of the 75-mm gun in the M24, which lacked sufficient power to overcome the armor of the T34 at most angles of impact or location, the guns mounted in our tanks in Korea were able to penetrate with relative ease the armor of the T34 when HVAP or APC ammunition was used. HVAP ammunition was particularly effective, especially in the 90-mm gun of the M46 or M26. A number of cases are reported of projectiles of this type penetrating enemy armor and then passing out through the other side. Gunnery was generally good; hits were registered usually on the first shot (see Appendix D). Opening ranges varied from point blank to 2,000 yards. However, on the average the opening ranges were less than 800 yards (see Appendix A). Gun stabilizers and

cant correctors were not used under the terrain conditions of Korea and could have been eliminated since these devices occupied needed space and required considerable maintenance.

Tank Units in Korea

Tables I and II show the armored units of the UN forces in action in Korea. While the designation, equipment, and assignment of some units, particularly the tank battalions, has been changed from time to time, it is believed these tables are essentially correct as of 1 January 1951. It will be noted that the distribution of tank units to the divisions varies considerably. However, as of the first of the year, each US division was authorized a standard tank force of one tank battalion of three companies, three regimental tank companies, and one division reconnaissance company. With the exception of the reconnaissance companies and the tank unit of the 187th RCT Airborne, which are authorized M24's, all tank units except those with the Marines are supposed to be eventually equipped with M46's. The Marines will continue with M26 tanks.

However, the actual armored strength has been dependent on the supply of trained personnel, and, lacking such personnel, a number of tank companies have not been activated. Furthermore, the types of tanks assigned have varied because of the limited supply of the authorized types in the Far East.

In addition to armored units shown in the tables, three tank units of the 29th British Brigade have been in action with the British cruiser tank, the 55-ton Centurion, the 40-ton Churchill infantry-support tank equipped with flame throwers, and the 28-ton Cromwell reconnaissance tank.

After some experience with the Centurion, it was found that this type of tank was not particularly suited for the operational and terrain conditions encountered in Korea. It is primarily a heavy-gun tank designed for the express purpose of fighting heavy enemy armor, which by the time the Centurion reached Korea had been largely destroyed. It is not equipped with adequate small arms for employment as an infantry-support weapon.

Under the road conditions of Korea, its weight and length were a severe handicap, restricting its operation to the main roads. Its limited refueling range, approximately 40 miles, was a further handicap because it required too frequent refueling on the march.

Tactical Employment of Enemy Armor

When the North Korean army crossed the 38th parallel 25 June 1950, the spearhead of their advance was the 105th Armored Division consisting of three tank regiments, the 107th, 109th, and

TABLE IA

EIGHTH ARMY ARMOR ORGANIZATION AND AUTHORIZED STRENGTH*

24th Inf Div		25th Inf Div		2nd Inf Div		1st Cav Div	
Units	No. Tanks	Units	No. Tanks	Units	No. Tanks	Units	No. Tanks
Div Tk Bn 6th Med, A-D Co's (a)	80	Div Tk Bn 89th Med, A-D Co's (d)	80	Div Tk Bn 72nd Hvy, A-C Co's (d)	76	Div Tk Bn 70th Hvy, A-C Co's (d)	76
		79th Hvy, A Co (c)**	24				
Tk Co's with Inf Regts 5th, 21st, (b) (19th, none)	46	Tk Co's with Inf Regts None	0	Tk Co's with Inf Regts 9th, 23rd, and 38th (b)	69	Tk Co's with Inf Regts None	0
Recon 24th (c)	7	Recon 25th (c)	7	Recon 2nd (c)	7	Recon 16th (c)	7
TOTAL	133		111		152		83

(a) Each company equipped with M46's.
(b) Each company equipped with M4A3's.
(c) Equipped with M24's.
(d) One company equipped with M26's and the remaining companies with M4A3's.

* M4A3 dozers and M32 retrievers are included in unit strengths.
** Company A, the only company of the 79th Tank Battalion in existence, was assigned temporarily to the 25th Infantry Division.

TABLE IB

OTHER UNITS

Unit	No. Tanks
503rd Recon Co	7 M24's
Tk Co, 187th RCT	7 M24's
29th Brigade (British)	
Hq 8th Hussars	4 Centurions
A Squadron	20 Centurions
B Squadron	20 Centurions
C Squadron	20 Centurions
7th Royal Tk Regt	
C Squadron	20 Churchills
Cooper Squadron	14 Cromwells

TABLE II

X CORPS ARMOR ORGANIZATION AND AUTHORIZED STRENGTH

1st Mar Div		7th Inf Div		3rd Inf Div	
Units	No. Tanks	Units	No. Tanks	Units	No. Tanks
Div Tk Bn 1st, A-D Co's (a) Flame Plat(b)	84 9	Div Tk Bn 73rd Hvy, A-C Co's (d)	78	Div Tk Bn 64th Hvy, A-C Co's (d)	78
Tk Plats with Inf Regts 1st, 5th, and 7th (c)	15	Tk Co's with Inf Regts 31st, 32nd, and 17th (e)	69	Tk Co's with Inf Regts 7th, 15th, and 65th (e)	69
Recon None	0	Recon 7th (b)	7	Recon 3rd (f)	7
TOTAL	108		154		154

(a) Each company equipped with 17 M26's, 3 M4A3 dozers, and 1 M32.
(b) Equipped with M4A3's.
(c) Each platoon equipped with 5 M26's.
(d) Each company equipped with 22 M26's, 3 M4A3 dozers, and 1 M32.
(e) Each company equipped with 22 M4A3's and 1 M32.
(f) Equipped with M24's.

203rd, all equipped with the obsolescent T34 Russian medium tank, with about 160 tanks in all. This division was later reinforced by the 16th and 17th Armored Brigades which were, in reality, small armored regiments or lage battalions, as they had, respectively, 43 and 40 tanks (see Appendix F).

The division, when it reached Chochiwon, split into its component regiments which thereafter operated independently in the Chogye, Kumchon-Waegwan, and Tabu-dong areas. The brigades were moved from Pyongyang sometime after the conflict began. The 16th appeared in action for the first time on the Naktong front in the attack toward Yongsan about 1 September. The 17th appeared about the same time in the Uidung area northeast of Taegu.

Other armored units known to have been activated prior to November 1950 were the 17th Mechanized Division with 41 tanks; the 41st, 45th, and 46th Armored Regiments with 10 tanks each; and the 43rd Mechanized Regiment with 13 tanks. The original strength of all these units was about 320 tanks, and up to November 1950 they are believed to have received some 250 replacements.

In the early stages of the war, tanks were, boldly sent in daylight down the lines of advance far in front of the main body, for their effect on the morale of the resisting ROK Army (see Appendix D). The ROK's had little, except a few 57-mm AT guns and 105-mm howitzers, to combat them. The 24th Infantry Division, when it reached Korea, was not able to help materially because its weapons were not adequate for the job. The few light tanks with which the division was equipped were virtually the only antitank weapons available; the 2.36-inch bazooka was effective only at very short ranges and could then penetrate only certain parts of the armor if the angle of impact was close to 90°. As previously mentioned, the M24 with its 75-mm gun and light armor was easily overcome by the heavier and more powerful T34 with its 85-mm armament.

Consequently, small groups of enemy tanks repeatedly penetrated our positions in the front and flanks, overran our troops, and thrust through to command posts and artillery positions. These tank attacks were followed quickly by infantry, in some cases with more tanks.

With the arrival of bomber and fighter aircraft, more artillery, better tanks, and the 3.5-inch bazooka, the losses in enemy armor mounted rapidly, forcing a change in tactics. Tanks were moved only at night and concealed during the day in groves, camouflaged positions dug into hillsides, villages, and other locations where advantage could be taken of the terrain and foliage. The night movement of the tanks was made at slow speed because of the condition of the roads and limited visibility.

TABLE IIIB

TANK CASUALTIES AND LOSSES BY TYPE

	Mech. Failure	Tank Fire	Inf Attack	Terrain	Mines	AT Guns	Mor-tars	Abandoned: Tactical Causes	Ai
M46	72 (32)	1 (0)	1 (1)	2 (2)	3 (0)	— —	— —	— —	1
M26	102 (24)	3 (2)	3 (3)	8 (7)	24 (3)	4 (2)	3 (0)	9 (9)	—
M45	6 (0)	— —	— —	2 (0)	— —	— —	— —	— —	—
M4A3[a]	105 (40)	11 (7)	3 (3)	33 (31)	33 (14)	15 (11)	4 (0)	8 (8)	6
M32	15 (2)	— —	2 (2)	1 (1)	2 (1)	— —	— —	1 (1)	—
M24	38 (7)	2 (2)	1 (1)	5 (5)	2 (0)	7 (4)	1 (1)	3 (3)	1
Centurion	7 (1)	— —	— —	— —	— —	— —	— —	— —	—
Churchill	2 (0)	— —	— —	— —	— —	— —	— —	2 (2)	—
Cromwell	— —	— —	12 (12)	— —	— —	— —	— —	— —	—

(a) Includes dozers

TABLE IIIC

TANK CASUALTIES AND LOSSES BY TYPE AS PERCENTAGES OF NUMBERS I

Numbers[a]		Mech. Failure	Tank Fire	Inf Attack	Terrain	Mines	AT Guns	Mortars
173	M46	41.6 (18.5)	0.6 (0)	0.6 (0.6)	1.2 (1.2)	1.7 (0)	— —	— —
252	M26	40.5 (9.5)	1.2 (0.8)	1.2 (1.2)	3.2 (2.8)	9.5 (1.2)	1.6 (0.8)	1.2 (0)
8	M45	75 (0)	— —	— —	25 (0)	— —	— —	— —
516	M4A3	20.3 (7.75)	2.1 (1.4)	0.6 (0.6)	6.4 (6.0)	6.4 (2.7)	2.9 (2.1)	0.8 (0)
113	M24	33.6 (6.2)	1.8 (1.8)	0.9 (0.9)	4.4 (4.4)	1.8 (0)	6.2 (3.5)	0.9 (0.9
71	M32	21.2 (2.8)	— —	2.8 (2.8)	1.4 (1.4)	2.8 (1.4)	— —	— —
64	Centurion	10.9 (1.6)	— —	— —	— —	— —	— —	— —
20	Churchill	10.0 (0)	— —	— —	— —	— —	— —	— —
14	Cromwell	— — —	— —	85.7 (85.7)	— —	— —	— —	— —
1231								

(a) Numbers include tanks in hands of troops, ordnance, field maintenance units, all losses since 1 July 1950, on hand in depots (Korea) and unserviceable tanks evacuated to Japan or the Zone of the Interior. Information to 21 January 1951, source Tank Status Reports, Ordnance Officer, FECOM.

TABLE IIIB

CASUALTIES AND LOSSES BY TYPE

Mines	AT Guns	Mor-tars	Abandoned: Tactical Causes	Artil-lery	Accidental Cause	Total Casualties and Losses
3 (0)	— —	— —	— —	1 (1)	7 (4)	87 (40)
24 (3)	4 (2)	3 (0)	9 (9)	— —	— —	156 (50)
— —	— —	— —	— —	— —	— —	8 (0)
33 (14)	15 (11)	4 (0)	8 (8)	6 (4)	2 (2)	220 (120)
2 (1)	— —	— —	1 (1)	— —	— —	231 (7)
2 (0)	7 (4)	1 (1)	3 (3)	1 (0)	1 (1)	61 (24)
— —	— —	— —	— —	— —	— —	7 (1)
— —	— —	— —	2 (2)	— —	— —	4 (2)
— —	— —	— —	— —	— —	— —	12 (12)

TABLE IIIC

SSES BY TYPE AS PERCENTAGES OF NUMBERS INVOLVED

errain	Mines	AT Guns	Mortars	Abandoned: Tactical Causes	Artillery	Accidental Cause	Total Casualties and Losses
.2 (1.2)	1.7 (0)	— —	— —	— —	0.6 (0.6)	4.0 (2.3)	50.3 (23.1)
.2 (2.8)	9.5 (1.2)	1.6 (0.8)	1.2 (0)	3.6 (3.6)	— —	— —	61.9 (19.2)
25 (0)	— —	— —	— —	— —	— —	— —	100 (0)
.4 (6.0)	6.4 (2.7)	2.9 (2.1)	0.8 (0)	1.6 (1.6)	1.2 (0.8)	0.4 (0.4)	42.6 (23.3)
.4 (4.4)	1.8 (0)	6.2 (3.5)	0.9 (0.9)	2.6 (2.6)	0.9 (0.9)	0.9 (0.9)	53.9 (21.2)
.4 (1.4)	2.8 (1.4)	— —	— —	1.4 (1.4)	— —	— —	29.6 (9.9)
— —	— —	— —	— —	— —	— —	— —	10.9 (1.6)
— —	— —	— —	— —	10 (10)	— —	— —	20 (10)
— —	— —	— —	— —	— —	— —	— —	85.7 (85.7)

ield maintenance units, all
rviceable tanks evacuated to
y 1951, source Tank Status

TABLE IIIA
EIGHTH ARMY AND X CORPS TANK CASUALTIES TO JANUA
(Figures in parentheses represent total loss

Army or Corps	Div	Unit	Cause of Casualties: Mech. Failure	Tank Fire	Inf Attack	Terrain	Mines	AT Guns	Mor-tars
Eighth Army	1st Cav	70th Tk Bn	16 (7)	5 (3)	1 (1)	13 (12)	24 (4)	2 (2)[a]	3 (0)
		16th Reconn	5 (1)	— —	— —	1 (1)	— —	— —	— —
	24th Div	6th Tk Bn	75 (30)	1 (0)	1 (1)	2 (1)	4 (1)	— —	— —
		24th Reconn	5 (1)	— —	— —	— —	— —	1 (1)	1 (1)
		Tk Co 5th Inf	10 (3)	1 (1)	— —	2 (1)	8 (3)	— —	— —
		Tk Co 21st	3 (2)	— —	— —	— —	1 (1)	— —	— —
		A Co 78th HTB[b]	5 (1)	2 (2)	1 (1)	2 (2)	— —	5 (2)	— —
	25th Div	89th Tk Bn	47 (13)	1 (1)	3 (3)	7 (7)	5 (3)	5 (5)[d]	— —
		25th Reconn	7 (1)	— —	— —	— —	1 (0)	— —	— —
		A Co 79th Tk Bn	11 (3)	— —	— —	— —	— —	2 (0)[e]	— —
	2nd Div	72nd Tk Bn	37 (12)	2 (1)		4 (4)	7 (1)		
		2nd Reconn	1 (0)	— —	1 (1)	— —	1 (0)	1 (1)	— —
		Tk Co 23rd Inf	12 (4)	— —	— —	— —	1 (1)	1 (0)[a]	— —
		Tk Co 38th Inf	3 (0)	1 (1)	— —	— —	2 (2)	2 (1)	1 (0)
		Tk Co 9th Inf			Information Incomplete[g]				
		503rd Reconn	1 (1)	— —	— —	— —	— —	— —	— —
		187th RCT			No casualties reported				
		British 29th Brigade	9 (1)	— —	12 (12)	— —	— —	— —	— —
X Corps as of 1 Jan 1951	1st Mar Div	1st Tk Bn	14 (8)	— —	3 (3)	2 (1)	7 (1)	4 (2)[h]	2 (0)
		Tk Pl 1st Mar	3 (0)	— —	— —	— —	— —	— —	— —
		Tk Pl 5th Mar	1 (1)	— —	— —	— —	— —	— —	— —
		Tk Pl 7th Mar			No casualties reported				
		Flame Plat	— —	1 (0)	— —	— —	— —	— —	— —
	7th Div	73rd Tk Bn	44 (0)	1 (1)	— —	1 (0)	2 (0)	— —	1 (0
		Tk Co 31st Inf	2 (2)	2 (1)	— —	6 (6)	— —	2 (2)[h]	— —
		Tk Co 32nd Inf	2 (0)	— —	— —	— —	— —	— —	— —
		Tk Co 17th Inf	14 (9)	— —	— —	1 (1)	— —	— —	— —
		7th Reconn	2 (2)	— —	— —	— —	— —	— —	— —
	3rd Div	64th Tk Bn	11 (5)	— —	— —	3 (3)	— —	— —	— —
		Tk Co 7th Inf	1 (0)	— —	— —	5 (5)	— —	— —	— —
		Tk Co 15th Inf	2 (0)	— —	— —	1 (1)	1 (1)	1 (1)[a]	— —
		Tk Co 65th Inf	2 (0)	— —	— —	1 (1)	— —	— —	— —
		3rd Reconn	2 (0)	— —	— —	— —	— —	— —	— —
TOTALS of Eighth Army			247 (80)	13 (9)	19 (19)	31 (28)	54 (16)	19 (12)	5 (1
TOTALS of X Corps			100 (27)	4 (2)	3 (3)	20 (18)	10 (2)	7 (5)	3 (0
COMBINED TOTALS			347 (107)	17 (11)	22 (22)	51 (46)	64 (18)	26 (17)	8 (1
PERCENT of Total Casualties			60.2	3.0	4.0	8.9	11.1	4.5	1.4
PERCENT of Total Losses			41.8	4.3	8.6	18.0	7.0	6.6	0.4

(a) Lost to bazooka; (b) This unit became Tk Co 21st Inf in summer 1950; (c) 13 additional casualties are reported prior to 10 November, cause unknown; (d) Believed bazookas caused three casualties; (e) 3.5 bazooka; (f) Data to November 1950 only; believed to have been 6 more casualties; (g) Reported to have lost 10 tanks; (h) 1 loss believed due to bazooka.

TABLE IIIA

RMY AND X CORPS TANK CASUALTIES TO JANUARY 1951

ures in parentheses represent total losses)

Cause of Casualties								
Inf Attack	Terrain	Mines	AT Guns	Mor-tars	Abandoned: Tactical Causes	Artil-lery	Accidental Cause	Total Casualties and Losses
1 (1)	13 (12)	24 (4)	2 (2)[a]	3 (0)	4 (4)	2 (0)	— —	70 (33)
— —	1 (1)	— —	— —	— —	1 (1)	— —	— —	7 (3)
1 (1)	2 (1)	4 (1)	— —	— —	— —	1 (1)	6 (3)	90 (37)
— —	— —	— —	1 (1)	1 (1)	— —	— —	— —	7 (3)
— —	2 (1)	8 (3)	— —	— —	— —	— —	— —	21 (8)
— —	— —	1 (1)	— —	— —	— —	— —	— —	4 (3)
1 (1)	2 (2)	— —	5 (2)	— —	— —	1 (0)	— —	16 (8)
3 (3)	7 (7)	5 (3)	5 (5)[d]	— —	7 (7)	2 (2)	2 (2)	79 (43)[c]
— —	— —	1 (0)	— —	— —	1 (1)	— —	— —	9 (2)
— —	— —	— —	2 (0)[e]	— —	— —	— —	1 (1)	14 (4)
	4 (4)	7 (1)			2 (2)	1 (1)	1 (0)	54 (21)
1 (1)	— —	1 (0)	1 (1)	— —	— —	— —	— —	4 (2)
— —	— —	1 (1)	1 (0)[a]	— —	— —	1 (1)	— —	15 (6)
— —	— —	2 (2)	2 (1)	1 (0)	— —	— —	— —	9 (4)[f]
Information Incomplete[g]								
— —	— —	— —	— —	— —	— —	— —	— —	1 (1)
No casualties reported								
12 (12)	— —	— —	— —	— —	2 (2)	— —	— —	23 (15)
3 (3)	2 (1)	7 (1)	4 (2)[h]	2 (0)	6 (6)	— —	— —	38 (21)
— —	— —	— —	— —	— —	— —	— —	— —	3 (0)
— —	— —	— —	— —	— —	— —	— —	— —	1 (1)
No casualties reported								
— —	— —	— —	— —	— —	— —	— —	— —	1 (0)
— —	1 (0)	2 (0)	— —	1 (0	— —	— —	— —	49 (1)
— —	6 (6)	— —	2 (2)[h]	— —	— —	— —	— —	12 (11)
— —	— —	— —	— —	— —	— —	— —	— —	2 (0)
— —	1 (1)	— —	— —	— —	— —	— —	— —	15 (10)
— —	— —	— —	— —	— —	— —	— —	— —	2 (2)
— —	3 (3)	— —	— —	— —	— —	— —	— —	14 (8)
— —	5 (5)	— —	— —	— —	— —	— —	— —	6 (5)
— —	1 (1)	1 (1)	1 (1)[a]	— —	— —	— —	— —	5 (3)
— —	1 (1)	— —	— —	— —	— —	— —	— —	3 (1)
— —	— —	— —	— —	— —	— —	— —	— —	2 (0)
19 (19)	31 (28)	54 (16)	19 (12)	5 (1)	17 (17)	8 (5)	10 (6)	423 (193)
3 (3)	20 (18)	10 (2)	7 (5)	3 (0)	6 (6)			153 (63)
22 (22)	51 (46)	64 (18)	26 (17)	8 (1)	23 (23)	8 (5)	10 (6)	576 (256)
4.0	8.9	11.1	4.5	1.4	4.0	1.4	1.7	100
8.6	18.0	7.0	6.6	0.4	9.0	2.0	2.3	100

: Co 21st Inf in summer 1950; (c) 13
) November, cause unknown; (d) Believed
oka; (f) Data to November 1950 only; be-
orted to have lost 10 tanks; (h) 1 loss

These tactics, coupled with the rather low noise characteristic of the T34, permitted the enemy to place his tanks in forward attack positions on a number of occasions without the knowledge of our forces. Long bursts of automatic-weapons fire were supposed to have been used by the North Koreans as a means of concealing the sounds of the night movement of their tanks, but interrogations of prisoners of war from tank units failed to confirm this supposed stratagem (see Appendix D). Main roads were used chiefly, with occasional use of secondary roads and farm lanes. Deployment off the roads into rice paddies or into the hills was a rarity.

In view of the improved quality of our defenses, tank attacks were made with more caution, usually at first light of day, closely followed by infantry. When the enemy was placed on the defensive after our crossing of the Naktong, 22 September, he employed his tanks and 76-mm self-propelled guns in more or less fixed positions--dug-in and camouflaged in buildings, mountain defiles, or road blocks--with the intention of ambushing our tanks and motor columns or placing them under flanking fire (see Appendix F). While these defensive measures theoretically provided the element of surprise, they were generally unsuccessful as the liaison aircraft patrolling ahead of our advance frequently detected these ambuscades. Sometimes, too, the bad gunnery of the North Korean tank and gun crews, at this period, enabled our tanks to overcome the initial element of surprise and return the fire effectively.

By the time the North Koreans had been forced back to the 38th parallel, their armored units had virtually ceased to exist. The 105th Armored Division was later reported reconstituted but its operations have been relatively limited. Losses in tanks were almost 100 percent. Information from prisoners of war indicates that the casualties among tank crews was also extremely high (see Appendix D).

UN Tank Casualties

Table III is a condensation of tank casualties and losses reported by US and allied armored units. The information is complete to January 1951 for all units, save two as indicated. Some additional casualties were incurred, in numbers not known, among tanks in the hands of ordnance and engineer units.

The X Corps casualty report was based on first-hand information obtained directly from the units involved (see Appendix B). The Eighth Army record is based on reports and material prepared by the units themselves and on information supplied directly (see Appendix E).

Table IV shows the authorized strength, the total casualties, and the percent casualties for all armored units on which

TABLE IVA

TANK CASUALTIES AND AUTHORIZED STRENGTH

OF ARMOR UNITS IN EIGHTH ARMY

Unit	No. Tanks Authorized*	Tank Casualties	
		No.	Percent of No. Authorized
70th Hvy Tk Bn	76	70	92
16th Recon Co	7	7	100
6th Med Tk Bn	80	90	111
24th Recon Co	7	7	100
Tk Co, 5th Inf	23	21	91
Tk Co, 21st Inf	23	4	17
A Co, 78th Hvy Tk Bn**	23	16	70
89th Hvy Tk Bn	80	79	98
25th Recon Co	7	9	113
A Co, 79th Hvy Tk Bn	24	14	58
72nd Hvy Tk Bn	76	54	72
2nd Recon Co	7	4	57
Tk Co, 9th Inf	23	8***	35***
Tk Co, 23rd Inf	23	15	65
Tk Co, 38th Inf	23	9	39
503rd Recon Co	7	1	14
Tk Co, 187th RCT	7	0	0
29th Brigade (British)	98	23	24
EIGHTH ARMY TOTAL	614	431	69

* Includes tanks, dozers, and retrievers.
** Became Tank Company, 21st Infantry prior to 31 August 1950.
*** Casualties not confirmed.

TABLE IVB

TANK CASUALTIES AND AUTHORIZED STRENGTH

OF ARMOR UNITS IN X CORPS

Unit	No. Tanks Authorized*	Tank Casualties	
		No.	Percent of No. Authorized
1st Tk Bn (Marines)	84	38	45
Tk Plat, 1st Marines	5	3	60
Tk Plat, 5th Marines	5	1	20
Tk Plat, 7th Marines	5	0	0
Flame Plat, Marines	9	1	11
73rd Hvy Tk Bn	78	49	63
Tk Co, 31st Inf	23	12	52
Tk Co, 32nd Inf	23	2	9
Tk Co, 17th Inf	23	15	65
7th Recon Co	7	2	29
64th Hvy Tk Bn	78	14	18
Tk Co, 7th Inf	23	6	26
Tk Co, 15th Inf	23	5	22
Tk Co, 65th Inf	23	3	13
3rd Recon Co	7	2	29
X CORPS TOTAL	416	153	36.8
EIGHTH ARMY AND X CORPS COMBINED TOTAL	1030	584**	56.7

* Includes tanks, dozers, and retrievers.
** Includes 8 reported casualties of Tank Company, 9th Infantry.

information is available. For the purpose of this analysis, X Corps is kept separate from Eighth Army because, in the period of this report, it was a separate unit operating in terrain and under conditions somewhat different from those of the Eighth Army.

Analysis of Causes of Tank Casualties. The definition of a tank casualty as used in this report is any occurrence that renders the tank temporarily or permanently unserviceable. Causes include enemy action, accident, terrain, abandonment, and mechanical failure. In many cases, a clear-cut and fair assessment of the cause of a casualty was difficult to make. Numerous instances occurred of relatively minor difficulties, such as thrown tracks, that caused tanks to become casualties because of the close proximity of the enemy. In such cases, it was always a problem to decide whether the casualty was the result of mechanical failure, terrain, tactical abandonment, or destruction by our own or enemy forces. In this report, it has been the policy to assess the casualty on the basis of the initial reason for the tank becoming disabled and not on a later action which might have wrought greater damage or destruction.

From figures supplied by the Ordnance Officer, FEC, and from Eighth Army tank status reports, a total of 1,231 tanks represents the sum of the tanks in hands of troops, in hands of field ordnance units, available for issue from corps or army storage, all losses from the beginning of the conflict, and all tanks evacuated to Japan or the Zone of Interior. This figure does not include tanks in depot storage in Japan. It is believed to represent as closely as present information permits, the total number of tanks issued for service at some period in the Korean campaign.

In the period between early July and mid-January 1951, 576 tanks of various types have become casualties in the Eighth Army and X Corps. On the basis of the total of 1,231 tanks, this represents a 43 percent casualty rate in the six-month period. The total losses in tanks in this group of casualties were 256 units, or 44 percent of the total casualties. The total loss rate as compared with the number of tanks in service was approximately 21 percent. Four hundred and eight, or 71 percent of the total casualties, were caused by reasons other than enemy action, i.e., mechanical failure, terrain, or accidents. Mechanical failure accounted for the bulk of the nonbattle casualties, representing 60 percent of all casualties. Of the remaining casualties, which were the result of enemy action, 64 tanks, or 11 percent of the total casualties, were damaged or destroyed by mines; 26, or 4.5 percent, were knocked out by antitank guns including bazookas (probably captured) in the hands of the enemy; 22, or 4 percent, were lost to infantry attack; and 17, or 3 percent, were casualties because of tank fire. Abandonment for tactical reasons accounted for 23, or 4 percent. Mortar fire and artillery caused 16 additional casualties.

Casualties Caused by Enemy Weapons. The efficacy of the various enemy weapons, which accounted for the 168 casualties chargeable directly to enemy action (excluding casualties caused by mechanical failure, terrain, or accidents), is shown in Table V.

TABLE V

CASUALTIES CAUSED BY ENEMY ACTION

Weapon	Casualties No.	Casualties Percent
Mines	64	38.1
Antitank guns	26	15.5
Tactical abandonment	23	13.7
Infantry action	22	13.1
Tank fire	17	10.1
Mortars	8	4.8
Artillery	8	4.8
TOTALS	168	100.0

The number of tank casualties caused by mines indicates the effectiveness of a well-planned mine program in a defensive operation. The North Koreans, while they employed mines far more effectively than the UN forces, did not, so far as the records show, use them in any great concentrations or in well-planned fields. Nevertheless, the rather random distribution of their mines was sufficiently effective to knock out nearly as many tanks (64 out of 145 if tactical abandonment is excluded) as all their other weapons combined. Furthermore, our tanks were not equipped with any devices for detecting or clearing mines. In fact, in some cases, tanks themselves were used to detect the presence of mines, and exploded them with resultant damage to the tank. Antitank guns appear to be the next most effective weapon, accounting for 26 casualties. An interesting aspect is the 11 casualties in this category that are reported as caused by bazookas. It may be presumed that most if not all of these weapons were captured material turned against our forces. It is also interesting to note, as is done later in this report, that among the North Korean tank casualties, 13 tanks were destroyed by bazookas. The tanks lost to infantry action are generally scattered among a number of tank units with one exception that tends to emphasize unduly the power of infantry to destroy tanks. This exception is the case of Cooper Squadron, 29th British Brigade which lost 12 Cromwells when these tanks were trapped at night in a narrow defile while withdrawing near Uijongbu (see Appendix E). If we neglect the score charged to captured bazookas and the Cooper Squadron incident, we find the enemy weapon that was most effective against our tanks, next to mines, was tank fire, which caused 17 casualties.

Reviewing the breakdown in Table III of percentage casualties by types involved, the higher percentage casualties among M4A3's and M24's from tank fire, antitank fire, and artillery follows a logical pattern when the lesser armor protection of these tanks as compared with M46 and M26 is considered. The high percentages of mine casualties among M26's and M4A3's as compared with other types is not believed to be particularly significant. These tanks were more numerous than the other types and were employed in all parts of Korea, and hence their exposure to mine fields would be somewhat greater.

Terrain Casualties. The percentages of casualties by types involved, chargeable to terrain, indicate to some degree the quality of cross-country mobility and maneuverability of the several types employed.

The higher power and improved transmission and steering systems of the M46 as compared with the M26 may account for the better record of the M46. The M4A3, with a 6.4 percent casualty rate to terrain, would seem to have the least mobility and maneuverability of all US tank-types used in Korea. However, its more convenient size and weight and its use in regimental tank companies may have led to its being exposed to greater terrain hazards than the heavier types (see Appendix J).

Casualties Through Mechanical Failure. The very great number of casualties that have been charged to mechanical failure (60 percent of all casualties) are deserving of particular examination. It is difficult on the basis of the information presently available to appraise this situation. Unquestionably, the rough and hostile terrain of Korea, the quality of maintenance and logistic support, the age and physical condition of some of the tanks employed, and the skill and training of tank crews are factors that bear heavily on this problem. The mechanical performance of the M46 and the M26, judging from the percentage of mechanical failure, 41.6 and 40.5 percent respectively, appears to be about equal. However, it is known that at least one battalion with M46's made it a policy to evacuate to ordnance practically all tanks with some mechanical difficulty. Other units merely treated such mechanical difficulties as routine unit maintenance and did not classify them as mechanical failures. This variation of policy tends to increase disproportionately the reported number of cases of mechanical failure for the M46.

In comparison with the heavier tanks, the mechanical performance of the M4A3 and the M24 is considerably better, with 20 percent mechanical failure for the M4A3 and 34 percent for the M24.

It should be remembered, in any consideration of mechanical failure by types, that the M4A3 and the M24 by 1950 were products

of a long period of development and modification and hence should be expected to perform with some measure of reliability. The M46 tanks were the first of this type to be built and their Korean employment was their first operational test. The M26 tanks were a later World War II development and were in a generally poor physical condition.

In an effort to shed some light on the nature of the mechanical failures that caused our tanks to become casualties, Table VI has been prepared, listing the various kinds of mechanical failures reported (see Appendix J). This listing is admittedly not as complete or as comprehensive as would be desirable in view of the importance of this casualty factor in our tank experience in Korea.

More mechanical failures are reported in Table VI than in Table III because there are a number of cases of tanks having had more than one mechanical failure. Of these mechanical failures, 107 are counted as total losses. However, 102 of these total losses had to be abandoned or destroyed because the tactical situation prevented them from being retrieved or evacuated. It is presumed that all could have been repaired and returned to service if time and means of recovery had been available. Many of these total losses occurred on the withdrawal from North Korea which required tanks to make long road marches and increased considerably the incidence of mechanical failure.

The greatest single cause of mechanical failure seems to be the power plant, with 80 failures reported. On a percentage basis, the engines of the M26 and M24 were the least reliable of all types of tank power plants. The next most common mechanical failure was the transmission, including clutches and gearing, with the M46 transmission the most troublesome. Tracks and final drive failures were numerous but, in proportion to the numbers of types involved, were about equal among all types. Other rather conspicuous mechanical difficulties were the cooling systems in the M26, and the lubricating and junction boxes in the M46.

Land Mines. Land mines (see Appendix I) were the most effective weapons the enemy used against US armor, accounting for 38.1 percent of the casualties caused by enemy weapons. In fact, excluding tactical abandonment, land mines secured 64 out of 145 US casualties, or nearly as many as all other enemy weapons combined. To do this, it is unlikely the enemy used more than 5,000 AT mines for the entire period. This enemy success was due in a large measure to his use of improvised, unpredictable mine field emplacements, often staggered in considerable depth, so that a vehicle could not weave its way through without detonating at least one mine. Mines were placed in ruts, tire tracks, and other places where heavy traffic was indicated, and on the shoulders of the road. They were generally well-sited, cuts and fills and narrow by-passes being used, and it would appear that the patterns

TABLE VI

CAUSES OF MECHANICAL FAILURE BY TANK TYPE

	M46		M26		M4A3		M32		M24		M45	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
No. of tanks in service	173	-	252	-	516	-	71	-	113	-	8	-
Engine	7	4	26	10	31	6	4	6	12	10	-	-
Transmission (including gears, clutches)	15	9	10	4	10	2	3	4	7	6	-	-
Tracks, final drive, suspension	6	3	13	5	18	4	4	6	2	2	1	12
Cooling system (including radiators)	6	3	15	6	4	1	-	-	-	-	1	12
Lubricating system (oil lines, coolers)	14*	8	11	4	2	5	-	-	1	1	3	37
Engine assessories (aux, engines, manifolds, starters, etcetera)	3	2	4	2	3	5	1	1	-	-	-	-
Gun and recoil mechanism	3	2	4	2	2	5	-	-	8	7	-	-
Turret mechanism	-	-	2	1	2	5	-	-	-	-	-	-
Steering	1	1	4	2	3	5	-	-	-	-	-	-
Electrical system	9**	5	1	1	2	5	-	-	1	1	-	-
Gas tanks	2	1	2	1	-	-	-	-	-	-	-	-
FW&T (including general repairs)	10	6	8	3	8	2	-	-	5	4	-	-
Freezing	-	-	5	2	3	5	-	-	-	-	-	-
Unspecified	-	-	-	-	24	5	4	6	2	2	-	-

* All failures occurred in the oil cooling system.
** All failures occurred in the master junction box.

were improvised at the time of laying, with regard to the terrain, the number of mines available, and the amount of time to do the job. Often the fields were not covered by fire. Many armor casualties occurred because the UN forces accepted the risk of mines while going ahead rather than suffering the delay of slow probing for the irregularly spaced mines.

The UN forces expended a much larger number of AT mines, using the current doctrine of mine patterns covered by fire. Detail on enemy damage and subsequent recovery is lacking. It is estimated that the enemy achieved an exchange rate of better than one US tank casualty for every 100 AT mines laid. It is to be noted that enemy armor had been absent from the battlefield since November 1950 and was generally in retreat after mid-September; enemy armor was thus exposed to less mine hazard.

The UN forces were handicapped by a lack of troops trained in mine usage; hence mines were often not laid skillfully and deceptively. The engineer troops who were skilled often were not available for extensive mine-field work, being pressed into service as infantry when the tactical situation was critical.

The supply of AT mines was generally adequate in Korea but problems did arise in transporting them to the troops in quantity in sufficient time to be used.

The reporting by UN units of their use of mines was deficient. G-2 of the EUSAK Engineers reported that of some 123,250 AT mines expended, reports were made on only some 13,200. Of some 239 reports received, fewer than five were from units other than engineers.

The Korean experience has indicated the potential effectiveness which could be obtained by use of remote-laid mines using air, artillery, or rocket delivery. Such mines would have been especially useful for night interdiction of enemy supply lines, demoralization of repair crews, and harassment of troop concentrations; they could furnish a continuous disruption to the enemy.

The use of earth augers to simplify the emplacement of AT mines (as proposed in ORO-T-109) was tested in the field in Korea and proved to be efficient and satisfactory. These field tests are described in detail in Appendix I, Annex 7. It was found that AT mines could be speedily emplaced with earth augers, and would be difficult to detect. Each auger could comprise an independent unit carrying up to 50 mines on the vehicle, and would require only a small working crew.

The land-mine evaluation clearly showed the need for a lethal mine, and the enemy performance pointed out the effectiveness of using mines in unpredictable improvised patterns in depth.

Tank Casualties Before and After CCF Attack. As a final step in the analysis of UN tank casualties, the casualties and losses before and after the intiial attack of the Chinese Communist forces on 1 November are presented in Table VII (see Appendices B and E). The marked change in the incidence of the

TABLE VII

TANK CASUALTIES AND LOSSES IN KOREA

BEFORE AND AFTER 1 NOVEMBER

(Figures in brackets denote total losses)

	Before 1 November	After 1 November
Mechanical failure	148 (7)	199 (100)
Tank fire	17 (11)	0
Infantry attack	3 (3)	19 (19)
Terrain	22 (17)	29 (29)
Mines	60 (14)	4 (4)
Antitank guns	15 (8)*	11 (9)**
Mortars	5 (1)	3 (0)
Tactical abandonment	7 (7)	16 (16)
Artillery	8 (5)	0
Accident	6 (2)	4 (4)

* Includes two casualties to bazookas
** Includes nine casualties to bazookas

casualties and losses from various causes willbe noted. After 1 November, no casualties occurred from either tank fire or artillery, and mine casualties decreased sharply. Casualties from mortar and antitank fire remained essentially unchanged but the casualties from infantry attack increased considerably. However, the experience of Cooper Squadron (see "Casualties Caused by Enemy Weapons") should be here kept in mind.

The most significant aspect of this comparison is the change in the ratio of casualties to losses. Of the 291 tank casualties that occurred prior to 1 November, 75, or 26 percent, became total losses. Among mechanical failure casualties, only seven tanks, or 5 percent, were not repairable or recoverable. A number of tanks, casualties from enemy weapons or terrain, were always recovered, repaired, and returned to service. After the first contact with the Chinese and our withdrawal from our extended positions in North Korea, our ability to support armor was seriously impaired. Our tank casualties after 1 November were 291, almost equal to our previous casualties. Of these 291 casualties, 181, or 60 percent, were total losses. Of the

199 mechanical-failure casualties that took place after 1 November, 100, or 50 percent, became total losses. Terrain casualties were 100 percent total losses and an increased proportion of tanks, damaged by enemy action, were completely lost. The high percentage of total losses was caused by the lack of spare parts, the great distances separating tank units from their ordnance support units, and the general withdrawal operation which was taking place. Many tanks becoming casualties could have been recovered, repaired, or evacuated had the circumstances permitted.

This situation is illustrative of the price that must be paid when armor is committed in the hostile environment of an extremely mountainous terrain and in winter weather, extended and dispersed over an extensive area, and receives quite inadequate logistic or maintenance support.

Suitability of Tanks for Korean Service. Considering the total casualties by types, the M4A3, despite the apparent inferior mobility record as indicated by its terrain casualty rate and its somewhat greater vulnerability to various enemy weapons, appears to have been the tank most suited to the particular environment and campaign characteristics of Korea (see Appendix J). The major factor in this is the better mechanical performance of the M4A3 in this rough and mountainous country with limited logistic and maintenance support. It seems reasonable to suppose that a more modern tank of the same class with improved armor protection and mobility, but retaining the gun power of the M4A3, would have proved an ideal type of tank for use in Korea or for any future operations under comparable conditions.

The influence of weight and dimensions on the tank casualty rate is not easily determinable from the information. The lighter tanks, benefitted by a longer period of development, had fewer mechanical failure rates and compare favorably with heavier and larger tanks in the over-all casualty rate. This, coupled with their considerably lower fuel consumption, makes for a much easier logistic effort for their support. It certainly follows that tanks of the characteristics of the new medium T42 and the new light T41 would have fulfilled the armor requirements to date in Korea provided no armor of the nature of the JS-III had been encountered.

Fuel-consumption figures in Korea show that the family of water-cooled, gear-driven and manually controlled tanks have a linear relation between tank weight and gasoline consumption, i.e., approximately 0.065 gallons per ton-mile. The M46, with a hydraulic torque converter, appears to be less efficient on a ton-mile consumption basis by about 30 percent. This factor, coupled with its 14 tons extra weight, accounts for the high M46 fuel consumption of about 4.5 gallons per mile in Korea, as compared with 2.5 gallons per mile for the M4A3. It is estimated that the T42, with approximately the same weight as the M4A3, but

with a hydraulic torque converter, would have a fuel consumption of 3.3 gallons per mile. A study has been made of the fuel logistics of these tanks, and it is estimated, on the basis of these fuel consumption figures, that if 10,000 tanks were running the equivalent of 20 miles per day, as might be the case in Europe, the extra logistic requirement of 10,000 M46's over 10,000 M4A3's over a six-month period would be 4 tankers, 882 tank cars, and 540 trucks; and the extra requirement for the M46 over the T42 would be 2.4 tankers, 531 tank cars, and 324 trucks. Although this would only be a small proportion of the total transport available, any reduction in the number of vehicles would lead to a corresponding reduction in drivers, maintenance personnel, spare parts, and shipping space required. Alternatively, the saving would provide fuel for 300 daily F80 sorties if T42's were employed instead of M46's, and 500 daily sorties if M4A3's were used instead of M46's. During wartime another important consideration would be the saving of 13 tons of steel per tank, amounting to half a million tons of steel if 40,000 T42's were built instead of M46's. It is therefore considered desirable that the US should produce a medium tank with the lowest possible weight for equivalent performance on the battlefield. Since it is believed that the T42 would be equal or superior to the M46 on the battlefield, it should be introduced at the earliest possible moment.

Reporting System on Armor Casualties. The analysis of armor operations in Korea has been rendered difficult by the lack of adequate records on tank casualties (see Appendix A). As previously stated, much of theinformation on this subject had to be obtained by interview with each individual tank unit when and if it could be reached. This resulted in serious delays and a lack of up-to-date information. A daily tank status report is presently being submitted by the various tank units to Eighth Army, and it is recommended that this report be submitted in writing through channels and amended to include:

1. Number of casualties in period of report.

2. Causes of casualties.

3. Information on disposition of casualties (i.e., total loss, repaired, or evacuated).

4. Number of replacements.

5. Number of evacuations.

6. Any pertinent information that may have some bearing on the preceding.

North-Korean Tank Casualties

In September and October 1950, seven survey parties were

organized by the Operations Research Office and sent to inspect all the enemy tanks and self-propelled guns that could be found. These parties located 239 T34 tanks and seventy-four 76-mm self-propelled guns that had been lost in combat or abandoned for various reasons along the principal routes of the Korean campaign, extending from the Pusan perimeter to the area of Pyongyang. These 239 T34's represent approximately a 40 percent sample of the total number of T34's (estimated at about 600) that the North Korean Peoples Army committed in the period of this report. The survey parties were made up for the most part of armor, ordnance, air force, and artillery officers detached from their units and attached for temporary duty to ORO for the purposes of the survey.

The operations and results of these surveys are reported in detail in Appendix K. It should be borne in mind that several surveys found T34's that had been knocked out in the period of our retirement in July, August, and early September. These "old" kills had been "cannibalized," attacked repeatedly by our aircraft, and frequently fired on again by friendly ground forces during our subsequent advance. Consequently, an accurate analysis and assessment of the original cause of disablement was impossible. Furthermore, the surveys could not hope to cover all enemy tank casualties, since tanks damaged but recovered and repaired are not represented. The testimony of interrogated prisoners of war indicates that spare parts were practically nonexistent and that removal of useful parts from badly damaged tanks was a necessary and common practice among North Korean armored units (see Appendix D). This testimony is confirmed by the physical condition of many of the vehicles examined by the survey parties.

A few surveys were able to operate directly behind the advancing front line and therefore were able to obtain fresh and first-hand evidence.

Table VIII summarizes the assessed causes of losses to the 239 T34 tanks which were examined by the teams. In using this table, one should keep in mind the many serious reservations applicable to the findings of these surveys.

In order to provide a basis of comparison of the losses of UN tanks (Eighth Army and X Corps combined) and North Korean tanks, Table IX has been prepared. In this table, North Korean losses to all types of air attack are combined.

On the basis of the record, the greatest single cause of loss in NK T34's would seem to be UN air attack, which accounted for 102 out of 239, or about 43 percent of the total losses. Napalm appears to be the most effective weapon of all, accounting for 60, or about 25 percent of the total count. Abandonments, in most instances without any visible evidence of cause, accounted for 59, almost another 25 percent of the total count. Tank fire was the third largest single cause, knocking out 39 tanks, or about 16 percent.

TABLE VIII

NORTH KOREAN T34 TANK LOSSES

	Number	Percent
Napalm	60	25.0
Abandoned:--no specified cause	59	25.0
Tank fire	39	16.0
Air rockets	17	7.0
Unknown	15	6.0
Bazooka	13	5.0
Air (not specified)	10	4.0
Bombs	7	3.0
Strafing	7	3.0
Mechanical failure	4	2.0
Artillery	5	2.0
Mines	1	0.5
T/6 Aircraft	1	0.5
Abandoned:---tactical causes	1	0.5
TOTALS	239	100.0

TABLE IX

NORTH KOREAN AND UN TOTAL LOSSES
(By percent)

	NK	Eighth Army and X Corps
Air attack	43	0
Abandoned:---tactical causes	25	9.0
Tank fire	16	4.3
Mechanical failure	2	41.8
Terrain	0	18.0
Mines	1	7.0
Antitank guns	5	6.6
Artillery	2	2.4*
Infantry attack	0	8.6
Unknown	6	2.3**
TOTALS	100	100

* Includes mortars
** Includes accidents

Napalm as a weapon to defeat armor must be given rather special consideration. It is essentially a weapon of an accidental nature. With the possible exception of the relatively rare occurrence of a direct hit, napalm does not of itself destroy or seriously damage a tank. However, it is fully capable of starting a chain of events which may bring about the loss of the vehicle. A napalm bomb, if a hit is registered sufficiently close to the tank, will splash its burning fluid on the tank. Because of the fire, the crew may suffer burns or be induced to abandon the tank. However from the prisoner of war interrogations it appears that tank crews usually had sufficient time to get clear before the fire had spread (see Appendix D). However, the abandonment of the tank ultimately led to its destruction, for the napalm from the first or successive strikes had sufficient time to ignite the rubber on the road wheels, heat the ammunition to the point of detonation, and set fire to the fuel. Any or all of these factors brought about the loss of the tank.

The number of mechanical failures found, four units, or two percent of the total, cannot be accepted as a reliable assessment. It has previously been noted that lack of logistic support in the North Korean Army forced their armor to effect repairs by removal of parts from tanks damaged beyond their capacity to repair. Furthermore, many casualties credited to other causes, such as air attack or ground fire, may have originally been caused by terrain, lack of fuel, or a mechanical failure difficult or impossible to detect by surface examinations. It seems reasonable, therefore, to presume that many tanks immobilized through mechanical failure, terrain, or fuel exhaustion were frequently attacked and further damaged by our forces without knowledge of their state of serviceability. The large number of abandonments also suggests that closer examination might have revealed these factors.

Antitank weapons, such as the bazooka, recoilless rifle, and mine, were relatively ineffective as judged by the evidence. Of the three, however, the bazooka appears to be the best by a considerable degree. Mine losses were insignificant despite the suitability of the terrain to the practical use of mines during certain periods of the campaign. The reports from the prisoners of war indicate that considerable mine casualties were incurred in North Korean armored units, but our failure to make the most effective use of the mines available permitted repairs to be easily effected, since our M6 mines used singly only blew the tracks of the T34's (see Appendix D). In addition, the methods employed by our forces in laying mines may not have been the most suitable for the particular situation (see Appendix I). The lack of sufficient engineer troops to lay mines may have had considerable bearing on this rather poor antitank-mine record.

In the course of the surveys, the various parties examined the 76-mm self-propelled guns that were encountered. Table X summarizes the causes of the casualties to these vehicles.

TABLE X

76-mm SP GUN CASUALTIES

	Number	Percent
Abandoned:--no specified cause	16	22
Napalm	13	18
Artillery	11	15
Strafing	9	12
Air rockets	7	10
Bombs	5	7
Bazooka	4	5
Unknown	4	5
Tank fire	3	4
Mines	1	1
Air (not specified)	1	1
TOTALS	74	100

As with the T34's, the record indicates that air attack was the largest single casualty-producing weapon. Thirty-five SP 76's, or 47 percent of the total, are credited to air. Napalm again appears to be the best air weapon, accounting for 13 guns, or 18 percent of the total. The number of SP 76 guns abandoned is large, 22 percent of the total losses. Artillery shows up well, with 11 gun casualties, or 15 percent of the total. Again it should be pointed out that mechanical failure, terrain, or fuel exhaustion may be large but concealed factors.

Table XI shows the combined casualties of both T34's and SP 76's. The combined losses show air activity accounting for

TABLE XI

COMBINED CASUALTIES T34's AND SP 76's

	Number	Percent
Abandoned:—no specified cause	75	24
Napalm	73	23
Tank fire	42	13
Air rockets	24	8
Unknown	19	6
Bazookas	17	5
Artillery	16	5
Strafing	16	5
Bombs	12	4
Air (not specified)	11	4
Mechanical	4	1.5
Mines	2	0.6
T/6 Aircraft	1	0.3
Abandoned: tactical causes	1	0.3
TOTALS	313	100

about 44 percent of the total. Abandonment represents about 24 percent of the total. The combined kill for bazookas was only slightly more than 5 percent. Tank fire was the third largest armor destroyer, accounting for 13 percent of the total.

Trafficability and Terrain

The nature of the terrain in Korea, predominantly rough and mountainous, has generally tended to restrict the movement of armor to the roads. The valleys, where normal deployment might be expected, are terraced into many small rice fields located at different levels and separated by numerous small dikes. These dikes range from narrow rice-paddy dikes 2 to 3 feet high to river-bank dikes 20 feet or more in height and wide enough for a roadway along the top.

The roads, particularly in the valleys and lowlands in the south, are of heavy crushed-stone construction, usually built well above the fields on either side at heights varying from 4 to 20 feet. The shoulders are 45° to 60° slopes and during the period of summer rains may be exceedingly soft because of the high level of the water table. In the mountains, both north and south, the main roads are of heavy construction but are very narrow and winding; they lack any form of safety device such as guard rails, curbs, or warning signals. Secondary roads may be mere trails used mainly by beasts of burden.

Relatively few bridges are either wide enough or strong enough to permit the passage of medium tanks, and by-passes are therefore common. In the south, by-passing does not, as a rule, present a serious problem so far as tanks are concerned since the stream beds are usually wide and shallow and approaches can be constructed both from and to the roads without difficulty. However, in the northeastern part of Korea where the X Corps operated, narrow ravines and gorges, 50 to 500 feet deep, were encountered and presented serious obstacles when a bridge had to be by-passed.

The terrain losses were all incurred through difficulties with obstacles cited previously--miring in rice paddies, collapsing road shoulders, bridge failures, ditching and running off roads, river crossings, and, in the north, ice and snow. Many of these terrain losses could of course have been recovered if the tactical situation had permitted or retrievers of sufficient power had been available.

In the relatively rare instances when deployment off the road was possible, tanks were able to operate in dry river beds and across unfrozen rice paddies under certain conditions. The tank units found that if a firm bottom existed not more than one foot below the paddy sludge and the tanks were not steered, the paddy could be crossed without miring. Preliminary reconnaissance

was, of course, necessary, and some tank units used a rough method of determining the trafficability of the paddy by having a man walk over the ground. If he did not sink over his boot tops, the ground was considered passable. Passage from one paddy to another was possible if the intervening dikes were not more than 2 to 3 feet high. Higher dikes caused the rear of the tank to mire and frequently to throw its tracks. There is one case recorded of an M26, in a demonstration, climbing a series of terraced rice paddies located on a 30° slope. The tank negotiated about 2,000 feet of this terrain but was stopped when it threw both tracks while making a slow turn (see Appendix B).

Dry or frozen rice paddies and corn fields presented no serious problem provided means could be found for maneuvering the tanks off and on to the roads again. In frozen paddies, it was good practice to avoid the trail of other tanks to prevent the destruction of the supporting surface.

The hill slopes are steep, bare, and eroded or covered with low growth in southern Korea and heavily wooded in the north. Movement of tanks up the slopes or along ridges or contour lines was not generally practical even if possible, as it was found that inclination of the tank sometimes prevented its gun from being depressed sufficiently to bear on the target. Tank support for infantry operating on such hill slopes was found to be more effective when the tanks remained in the valleys.

The light snow and glaze ice encountered thus far in Korea presented a serious mobility problem (see Appendix B). The steel tracks used on nearly all our tanks gave little traction under such conditions and caused a considerable number of terrain losses when tanks skidded or slid laterally off roads, particularly when attempting to negotiate sharp bends on mountain roads. Tank units found it necessary under such conditions to keep one track in the ditch to maintain control. In the mountains of northeast Korea, only careful driving and strenuous efforts on the part of the crews enabled the tanks to move with any degree of safety when snow and ice conditions were encountered.

Tank-Infantry Teamwork and Communications

The employment of tanks in close support of infantry has been discussed previously. The difficulties that have occurred in cooperative operations of this type have been caused by lack of experience and joint training and by inadequate communications. The infantry, under whose command the tank units generally operated, felt it necessary for tanks to be present in the line at all times and valued their protection and fire power. The attachment of US armor was usually one tank company to one regiment of infantry. However, it was not an infrequent arrangement to have tanks used in platoon--or even section--strength for particular operations. The deployment of armor in this manner

introduced many problems of command and of logistic support; these were difficult to solve because there was then prevalent in the lower echelons of our forces in Korea a general lack of experience and training in the use of armor. The command of the attached tank companies or platoons reverted to the senior infantry officer, who frequently failed to make the most effective use of the tanks assigned or to appreciate the heavy maintenance and refueling problem that characterizes armored warfare. By the same token, it was not uncommon to use tanks at night without proper provision for covering infantry to shield the tanks against sneak attacks. As the experience level of all the units involved rises, operations will become more efficient.

The proportion of tanks to infantry, one tank company to one regiment of infantry, appears to have been an effective arrangement under thelimitations imposed by the terrain. As several observers have remarked, Korea is a "one-tank front" country and the lead tank in a column restricted to the roads has to do most of the fighting.

Communications in Korea, between tanks and infantry and tanks and their command, have generally been unsatisfactory and exhibit no evidence of improvement over the quality of communications during World War II (see Appendix H). The difficulties of tank-infantry communications have prevented and inhibited the development of a fully coordinated and smoothly working tank-infantry team. Communications between tanks and infantry via the AN/VRC-3 set in the tanks and the SCR-300 can maintain satisfactory contact. However, the single SCR-300 set in the infantry company has not been adequate to handle all the normal traffic and still give sufficient information to individual tanks for proper target identification or to enable the tanks to maneuver with infantry. Many units suggest that each platoon of infantry be equipped with an SCR-300. The tank-infantry phone, which normally serves as a means of close-in communication, was not completely effective since infantrymen in many cases were not familiar with it or were reluctant to expose themselves to enemy fire while using it. The phone on the M26 was easily damaged, as infantry frequently failed to replace it in its receptacle and the tank in moving off either dragged or ran over the instrument. Because of the mountainous terrain and the distance between units, VHF communications between tank companies and battalion have been uncertain and communications often had to be maintained via the liaison plane when this plane remained within control of the battalion.

The suggestion has been made that until better communications can be established between tanks and infantry, a tank liaison officer be assigned to the infantry working with the tanks; this officer, via an SCR-300 set of his own, could direct the movement and fire of the tanks, just as the FO and TACP groups are now performing for their respective arms.

Cold Weather Operation

The difficulties of operating tanks on ice and snow-covered surfaces have been discussed previously (see also Appendix B). The lowest temperatures encountered were between -25 and -30°F up to 1 January 1951. With the exception of the mobility problem, the mechanical difficulties arising from cold weather were generally minor and correctable. Too liberal use of lubricants unsuitable for extremely low temperatures was common, and electrical failures tended to increase. The general maintenance effort was greater and harder to perform. For example, in 1st Marine Division operation around the Chosin Reservoir, it was found that under sub-zero conditions, to avoid cold casualties among the crew, the gassing of a tank required four to five times as long as in normal weather. Thus readying the tanks served as a drag on all operations.

From the point of view of the crews, tanks were extremely uncomfortable as the heavy winter clothing issued could not be worn by certain members of the crew and the tank heaters were entirely inadequate. Need of a better form of tank clothing is indicated.

Maintenance and Logistic Support

Tank maintenance in Korea was conspicuous for its difficulties. Three major factors were involved in this situation: first, the general failure of the logistic system to move enough spare parts forward to the tanks; second, the lack of training and experience among tank mechanics at nearly all echelon levels; and third, the tactical situation. In addition, Eighth Army has not had its full quota of ordnance supporting units; for tanks alone, each corps could have fully utilized three, instead of two, medium maintenance companies and one heavy maintenance company.

The quality of organizational maintenance and the age and physical condition of the equipment prior to its commitment in Korea unquestionably influenced the whole maintenance problem. It is known that a number of tank units had little training on the types of equipment that were issued, and others arrived with vehicles that had seen considerable service.

The spare-parts situation has been particularly critical. In the period July to January, our logistic build-up was not sufficient to deliver to the tank units their organizational spare parts as specified in the Department of the Army Supply Catalog ORD-7. The divisional or support maintenance units were likewise without any measure of their field maintenance spare parts and equipment (ORD-8). While it is recognized that the Marine Corps presents a somewhat special problem so far as army logistics are concerned, the 1st Marine Division departed from the US with spare parts of but 12 types for the support of four

companies of M26 tanks (see Appendix B). These parts were all that had been available to the unit up to 24 December.

ORD-8, SNL 6-226, Department of the Army Supply Catalog, on the M26 tank specifies over 1,200 separate items in quantities of one or more as the initial stockage of spare parts to be carried by a division with 60 to 100 tanks. Some of the difficulty stemmed from the lack of parts in storage in the Zone of the Interior (particularly for the M26 which was in process of conversion). However, transport and shipping restrictions on the movement of available spare parts from bases in Korea and Japan to forward elements, and to some extent the difficulty of establishing the identity of some parts shipped from the US without packing lists, hampered the supply exceedingly. Supply was further complicated by the frequent change of location of units, which resulted in delays in delivery or losses in transit of many shipments of spare parts. Consequently, stripping and exchange of parts from disabled tanks and in some cases outright cannibalization was necessary to obtain parts required to maintain other tanks in a serviceable condition.

Shortages of trained and experienced tank mechanics have further hampered the maintenance of tanks. It was noted that these shortages existed particularly on the third and fourth echelon levels where this type of skilled personnel is essential. Unfamiliarity with the mechanical arrangement of the M46 was rather general beyond the base level. As a result the mechanics of many tank units have perforce been carrying out repair operations much beyond their normal capabilities.

The tactical situation at certain periods deprived the tank units of maintenance support. At times great distances separated the tanks from their support units, and frequent changes of position prevented these support units from assembling their heavy equipment and stores. Where ordnance maintenance units had the opportunity to set up shop and establish reliable supply channels, the maintenance service and logistic picture was very much better.

From all indications, the supply of fuel and ammunition functioned satisfactorily with the one exception that many tank units with their own organic transport in a division or regimental pool reported difficulty in obtaining transport from regimental service or division truck companies to bring up the fuel from the supply point to the tanks. The high fuel consumption of the M46 (see Appendix J) made this transport problem a particularly difficult one, as additional cargo trucks were not provided divisions or units using this type tank.

Recommendations and Suggestions from Tank Crews

In the course of collecting material and information on the employment of armor in Korea, the views and opinions of personnel

who command or operate tanks were obtained. These opinions involve ideas about design features, weapons, arrangements, armor, mobility, equipment, and communications. Many of these ideas are incorporated elsewhere in this report. Some of the suggestions applicable to tanks of older models have been adopted in the design of the M46. However, for the record, these ideas and suggestions are collected together here:

Design. Provide a heavier and reinforced escape hatch which will not be blown in when an antitank mine is hit.

Weld additional baggage racks to the sides of turret or sponsons for the stowage of crew personal equipment, rations, lubricating oil, and water. Internal stowage would be desirable, if possible, since small-arms fire frequently destroyed this equipment. Racks for small arms ammunition for infantry are also useful.

Weld hand rails around the turret for infantry to hold while riding.

Place a light false deck over the engine louvers of the M46 to protect the men from heat when carrying infantry and to prevent dirt from entering the engine compartment.

Install an overriding gear on a drive shaft passing through the torque converter to allow engine compression to retard a tank on downhill slopes.

Provide some method of steering the M46 when it is under tow with the engine not running.

Provide means for closing hatches from theinterior of the tanks without exposing the crew to small-arms fire.

Design the driver's seat to recline for rest purposes when the tank is buttoned up for extended periods.

Provide protection for antenna bases to prevent destruction from small-arms fire.

Road wheel hubs are frequently penetrated by small-arms fire with resultant loss of lubricant. Make hubs sufficiently heavy to resist cal .50 fire.

Front bogies of tank dozers wear out at an excessive rate because of load concentration. Redesign the suspension. An angling device for the dozer would also be useful.

Improve traction with 2-inch pointed projectors or 1-inch chevron-type angle on tracks.

Provide a tank mine detector and remover mounted similarly to the tank dozer.

Increase diameter of the turret ring to provide more space internally.

Strengthen and simplify suspension to reduce mine damage, and to permit easier and more rapid repairs.

Provide tracks giving better protection and traction.

Armor and Armament. Increase the slope of all armor surfaces and make the armor as heavy as the power-weight ratio will permit. Eliminate vertical side plates and bulges.

Provide a cal .50 coaxial gun in front of the tank commander's hatch and give the bow gun greater traverse and elevation.

Provide a cal .50 gun on top of the turret that has 360° traverse and is capable of being fired without requiring the gunner to get out of the turret and expose himself.

Study the arrangement of the internal ammunition racks with the object of improving the handling of shells for the tank gun.

Communications. Provide a tank interphone system with a power unit independent of the radio.

Paint the tank-infantry phone on the tank a distinctive color so that it is clearly visible to the infantry.

Locate the tank-infantry phone in a position on the tank where it can be reached by a man in a nearly prone position.

Earphones in tanks are extremely uncomfortable. An earphone that is more comfortable and which would still permit the helmet to be worn is desired. Design a one-earpiece phone to permit the wearer to hear external sounds.

Provide means for launching pyrotechnics from tanks.

Place the tank commander's interphone-radio switch in front of the turret hatch.

Make switches of such a size and shape that they can be distinguished at night with gloved or mittened hands.

Improve the over-all performance of communications equipment, particularly the VHF sets, and combine tank-infantry and tank organic sets.

Equipment. Increase strength of tow cables, hooks, pintles.

Provide the tank commander with a simplified form of engineer bridge-reconnaissance card to enable reasonable estimates to be made of bridge capacities.

Provide the tank commander with a telescopic target-designating sight.

Make inspection plates flush with belly to avoid shearing off.

Protect periscopes against small-arms fire by metal backing.

Provide a hatch on the M32 to protect the crew when in close proximity to the enemy.

Powder fumes in the turret of the M26 cause great crew fatigue, nausea, and fainting. Provide blowers or evacuators if the tank is to continue in a sustained action.

Provide a range finder that controls the elevation of the gun tube in the same manner as the range finder of a camera.

The present heaters in tanks are inadequate. Provide a better type of heater.

Resume the use of the type of armored clothing worn in World War II.

Provide a better retriever for M46 tanks than the M32, with power at least equal to the M46 and good lifting characteristics.

Remove gyro-stabilizer and cant correctors as they are not used.

General. Tanks should be designed with the maximum attention given to simplicity and ease of maintenance and repair.

Tank parts should be interchangeable among various types of tanks to the maximum degree possible.

In order to give more effective supporting fire to infantry with the main armament, a proportion of medium tanks should be equipped with 105-mm howitzers.

CONCLUSIONS

Note: The conclusions made herein are derived primarily from the lessons and experience of the Korean campaign. In a military operation of a different character, certain of these conclusions may not be applicable or may have to be materially modified or altered.

1. UN tanks have been usefully and effectively employed in the Korean operation.

CONCLUSIONS

2. The terrain encountered in Korea limited the mass employment of tanks on a wide front as was common in Europe and Africa.

3. While terrain has denied the fullest use of armor, armor has been sufficiently versatile to serve in many different capacities. Some of these, such as convoy escort and patrol duties, have put heavy and uneconomical mileages on the tanks.

4. On the basis of Korean experience, some 150 tanks can be usefully employed by each infantry division, even in mountainous terrain.

5. The use and number of assigned tanks should be flexible depending on the team mission. The number may vary from a tank platoon per infantry company when the capture of a limited objective against normal opposition is involved, to one tank company per infantry company when the capture of a distant objective against heavy opposition is involved.

6. On the basis of their over-all performance and casualty rates, and considering their advanced state of mechanical development, the M4A3 and M24 tanks were best suited for use in Korea.

7. Medium tanks (i.e., M46's and M26's), while admittedly very powerful and effective weapons, were a very serious logistic and maintenance problem in Korea.

8. Mechanical failures among all types of tanks in Korea were extremely high.

9. On the basis of limited evidence, air attack accounted for 40 percent of all enemy tank losses in Korea, and 60 percent of all enemy tank losses caused by UN weapons.

10. On the basis of limited evidence, napalm was the most effective antitank air weapon thus far used in Korea.

11. NK mines caused 38 percent of US tank casualties arising from direct enemy action. Few of these casualties were total losses because of the low lethal effect of the mines.

12. NK minefields were laid in no predictable pattern over many miles of road, often without covering fire.

13. The NK exchange rate was better than one US tank casualty for every 100 antitank mines laid.

14. Tanks equipped with flails or some other type of antitank mine destroyer would have been useful in clearing mines and reducing tank casualties.

15. US armor was second to air in killing enemy T34 tanks.

POW information indicates that kills were generally obtained on the first round, and that there were few survivors among enemy tanks penetrated by US tank fire.

16. On the basis of the record, only a relatively small number of tanks was destroyed by bazookas.

17. Communications between tanks and infantry, and tanks and battalion headquarters, have been unsatisfactory through lack of training, inadequate equipment, and terrain.

18. The use of tanks as more or less fixed infantry antitank weapons or as convoy escorts is an expensive practice. Cheaper and more suitable weapons should be available for this purpose.

19. Tanks can be effectively employed at night if night vision devices are provided, and prior training in night operations with infantry is carried out. Night tank operations are necessarily restricted in scope and area.

20. The use of standard issue winter clothing by tank crews is impractical.

21. The logistic and maintenance support of tanks has been very inadequate.

22. Light aircraft operating with tank battalions have been invaluable for reconnaissance and maintaining communications when the companies have been spread over wide fronts.

23. On the basis of the burning of the rubber on tank road wheels with napalm, resulting in the destruction of the tank, tanks appear vulnerable to 40-KT atomic weapons attack up to a distance of 2,500 yards on a clear day, and 2,000 yards on a hazy day.*

RECOMMENDATIONS

Research and Development

1. Support a vigorous and extended research and development program to improve tank design, including emphasis on:

a. Improvement of mechanical simplicity and reliability of tanks, with special attention to interchangeability of parts and ease of maintenance.

b. Reduction of fuel consumption, by keeping weight to the minimum consistent with armor protection requirements, and by more effective utilization of power.

* See ORO-R-2 (FEC), Appendix A, for discussion.

4. Improve the quality of communications between tanks and infantry by improvement of equipment and training.

Logistics

5. Procure medium tanks at a rate that will provide about 150 tanks for each infantry division. This should be in addition to the requirements for armored divisions.

6. Choose a medium 35 ton tank for present US production in order to take advantage of its lower logistical support requirements and, as compared to the M46, its 30 percent saving in steel.

7. Produce T41 and T43 tanks at a ratio of about one-tenth each of medium tank production.

8. Strengthen normal maintenance and logistic support to armored units, particularly on divisional and forward support levels.

9. If armor is to be used in a terrain comparable to Korea, provide extra logistic and maintenance support.

10. Issue winter clothing that can be comfortably and conveniently worn inside a tank.

Training

11. Stress joint training at all levels at both infantry and armor schools, emphasizing to each branch the capabilities and limitations of each member in the infantry-armor-air-artillery team.

General

12. Give consideration to elimination of all devices of marginal utility in tanks, including:

a. Gyro-stabilizers.

b. Range finders.

c. Cant correctors.

c. The use of an infantry support gun such as the 105-mm howitzer in one version of the medium tank.

d. Continued over-all improvement of the mobility and agility of UN tanks, including improvement of track design.

e. A lightly armored highly mobile vehicle equipped with multiple automatic weapons of not less than cal .50 and not more than 40 mm, capable of delivering 360° fire against both air and ground targets, should be developed as an escort for motor convoys.

f. Provision of a night-vision device which will enable tanks to negotiate terrain and observe the movements of enemy infantry or tanks in darkness.

g. Provision of equipment for mounting on tanks as needed for the clearing and destruction of mine fields.

h. Development of a more effective type of long-range radio for tanks operating in hilly terrain.

2. Support a vigorous and expanded research and development program to provide a balanced family of antitank weapons without, however, either overemphasizing or neglecting the role of heavy gun tanks such as the US T43. This program to include emphasis on:

a. Development of an effective long-range antitank gun for use by the infantry. This gun should be capable of being moved over rough and unfavorable terrain, preferably in a light, highly mobile vehicle.

b. Development of a family of lethal, influence-fused antitank mines, with sterilizing and arming devices, suitable for remining by rockets, artillery, and air.

c. Simultaneous development of corresponding mine-detection and clearing devices.

d. Research and development on new types of air and ground munitions utilizing liquid fillers, such as napalm, chlorine trifluoride, pronock, and G-agents.

e. Continued development of special ammunition, such as shaped-charge and squash-head ammunition, together with improved bazookas and recoilless rifles.

Tactics

3. Develop tactics and techniques for statistical laying of lethal antitank mines.

APPENDIX A

ARMOR WARFARE IN THE

EIGHTH US ARMY IN KOREA

PROBLEM

1. The problem is to formulate the important operations-research elements of armored warfare as it has been conducted in the Korean campaign by US forces from 25 June to 1 October 1950.

FACTS

2. A survey of the experience of tank battalions that have fought in Korea was conducted under the leadership of Colonel William P. Withers, Armor Officer, Eighth Army. Dr. Ellis A. Johnson, Director of the Operations Research Office, and Colonel Joseph Colby, Deputy Commandant of the Detroit Arsenal, accompanied Colonel Withers. This trip required approximately 1,500 miles of travel by jeep during a three-week period and permitted a first-hand evaluation of terrain. In Annex A are listed the officers interviewed during the survey.

3. In Table I is a summary of the estimates of opening range of US tanks against various targets during the Korean campaign and an estimate of the expected range in western European combat. Table II presents a partial summary of US tank casualties. A summary of US casualties to North Korean mines is given in Table III.

4. There was general agreement among the armor personnel interviewed with respect to opinions held on the following points:

a. Tank, infantry, artillery and tactical air teams have been much more effective than they would have been operating separately. All are agreed that each member of the team is effective against particular kinds of targets that are difficult for other members of the team to kill.

b. Infantry is insistent that tanks accompany infantry in all major actions.

c. Armor is insistent that infantry accompany tanks in all armored action.

APPENDIX A

TABLE I

ESTIMATES OF OPENING RANGES IN YARDS AGAINST NORTH KOREAN FORCES AND IN ETO (To 1 October 1950)

Officer	T34 Tank	SP Gun	Infantry	Est for tanks in ETO future
Capt John Hiers CO, Co D, 6th Tk Bn	100-600	---	---	1500-2000
Lt Col John H. Growden CO, 6th Tk Bn	500-1000	---	---	100-1200
Lt Col C. Webber CO, 72nd Tk Bn	300-1000	---	---	---
Capt Wilfred O. Petit Co A, 72nd Tk Bn	300-1000	---	---	1000-1500
Lt Col Dolvin CO, 89th Tk Bn	1000-1500	1000-1500	0-500	---
Capt James R. Dew Co C, 89th Tk Bn	1500-2000	---	---	---
Capt H. Merchant Co A, 89th Tk Bn	---	1000-1500	500-1000	---
Lt Col C. S. Hannum CO, 73d Tk Bn	50-500	---	---	1500-2000
Capt J. D. Daughtery 73d Tk Bn	0-500	---	---	0-1500
Capt W. A. Casey 73d Tk Bn	0-100	---	---	0-1500
Lt O. M. Hearn 73d Tk Bn	0-500	---	---	0-1500
Capt W. O. Wade 73d Tk Bn	0-500	---	---	0-1500
Major W. B. Sadley 6th Tk Bn	500-1000	500-1000	500-1000	1000-1500
Capt J. F. Landers Co C, 6th Tk Bn	1000-1500	500-1000	---	---
Capt O. I. West Co B, 6th Tk Bn	1000-1500	500-1000	50-2400	---
Lt Col W. M. Rogers CO, 70th Tk Bn	---	100-1500	100-2500	

FACTS

TABLE II

PARTIAL SUMMARY OF US TANK CASUALTIES

(To 1 October 1950)

Agent	No.	Percent
Mines	50	69
T34	12	16
SP gun	3	4
Artillery	2	3
Captured & self-destroyed	3	4
Satchel charges	3	4
TOTAL	73	100

TABLE III

US TANK CASUALTIES TO NK MINES

(To 1 October 1950)

22-lb Mines*

Organization	No. Tanks Mines	No. Mines	Mines Per Tanks	Est Time Repair (days)
1. Co D, 6th Tk Bn	1	20	20	5
2. Co B, 6th Tk Bn	4	--	--	?
3. Co A, 6th Tk Bn	7	--	--	3 plus
4. Co C, 6th Tk Bn	3	--	--	3 plus
5. 89th Tk Bn	3	33	11	?
6. 73d Tk Bn	2	150	75	20 plus
7. A Co, 73d Tk Bn	2	66	33	killed
8. 70th Tk Bn	32	--	--	2 plus
Summary for 1, 5, 6, and 7	8	269	Av. 34	Av. 3 plus

* In some cases several mines were wired together.

d. <u>The volume of tactical air support has been at about the right level</u> and has been decisive in many actions.

e. The use of an air observer is essential to tank actions. There have been too few liaison aircraft available and as a result US tanks, for lack of reconnaissance, have fallen into enemy traps. Also, liaison pilots have been overworked and aircraft worn out. Not less than three L-5 aircraft should be attached to each tank battalion.

f. Previous army and air force neglect of joint infantry-tank-air training has had an exceptionally adverse effect upon the efficiency of team action in Korea.

g. Communication among the main members of the infantry-tank-artillery-air team has been very unsatisfactory and makeshift; the lack of adequate communication sets was the principal reason. This deficiency would have been remedied by joint training.

h. Most armor officers felt that they had been given inadequate support by both infantry and engineers, again chiefly because of lack of training.

i. Tanks are especially vulnerable at night to infantry attack because of their limited vision.

j. Tank crews especially dislike and fear night actions because of the disadvantage imposed on them by reduced vision.

k. The timing of ground action is such that air strikes should be provided within three to five minutes after call.

l. Heavy armor is an important psychological advantage in raising the morale of tank crews to a point where they will more willingly enter dangerous combat.

m. Enemy mines have been very effective. The enemy have laid their mines without any observable pattern; sometimes there have been only a few mines in a field, sometimes many; some fields have been protected by gunfire, many have not.

n. Tank crews especially dislike mines because there is no way to fight back.

o. Average tank combat speeds have been 5-10 miles per hour.

p. The US tanks, especially the M46, are equal or superior in mobility and probably are equal in agility to the T34.

q. US medium tanks that fought in Korea have been superior to the T34.

r. Tank maintenance in Korea has been handicapped severely by the lack of recovery vehicles and because ordnance had no opportunity to adequately stockpile spare parts.

s. It is especially difficult to maintain tanks when they are widely distributed in small groups in support of the infantry.

t. US tactics in maintaining tank movement has been an important factor in reducing US casualties.

u. Some kills of US tanks have resulted from indirect fires caused by such accidents as electrical short circuits. The fire, in turn, has exploded ammunition or fuel.

v. Fuel consumption for M4A3 tanks has averaged approximately three gallons per mile.

w. Cal .50 bursts usually average 10-15 rounds, principally because the gunner wants to see at least two tracers. Bursts of two or three rounds would be used, with a consequent saving of ammunition and transportation, if every round were a tracer.

x. It was estimated that the ratio of enemy dead to our own dead as a result of infantry-tank-air team action was between 10 and 50 to 1.

y. Many kills of the enemy have really been team kills in which one member of the team flushes the enemy and another member makes the kill.

z. There is some indication that US tanks do not burn as easily (from indirect fires) as the T34. This may be partly due to better ammunition storage in US tanks.

5. Several officers felt the major causes of US casualties to have been the following:

a. Tank crews getting out of a tank while under small arms fire.

b. Meeting enemy tanks at suicidally close range where superior tactics are impossible. This often has resulted from inadequate infantry support or liaison support aircraft.

c. Extensive enemy use of mines during their withdrawal.

6. Several armor officers stated their major concern with respect to enemy action was infantry attack. Attack at night is especially feared.

7. US armor units do not appear to maintain systematic statistical control records, since little or no factual data could be obtained on such subjects as gasoline consumption, casualties by cause, and repair time.

8. Many of the tanks sent to Korea appear to have had excessive wear before shipment.

DISCUSSION

9. Table II, although it contains only a fragmentary sample of US tank casualties, is probably representative of the percentage losses. It is probable, therefore, that enemy mines have accounted for a high percentage of US losses caused by direct enemy action. The tank casualties from mines have been repaired in from 3 to 30 days. Nevertheless, these tanks have been absent during times of critical need, and with superior design of mines, could have been permanent kills. The enemy mine success appears to have resulted in part from his introduction of laying mines in a statistical pattern (not according to any easily determined SOP in pattern) and his use of mines on the shoulder of roads, and partly from US inability to detect or clear the mines ahead of the tanks. This enemy use of mines is probably one of the most critical lessons to be learned from enemy tactics. The average overall exchange rate (mines laid per tank casualty) appears to be somewhere between 20 and 50.

10. The effectiveness of the infantry-tank-artillery-air team is not new. The lesson has been relearned. All of the evidence indicates that such a team can become, in any terrain, a devastating military unit; that lack of training has made it far less effective in Korea than it ought to have been; that the Eighth Army has been forced not only to fight with meager logistics but simultaneously to train its personnel in ground tactics. This has severely handicapped the ground commander.

11. The argument that tanks are obsolete (because new weapons have made them more vulnerable) appears to have little merit. Almost every weapon is armed against the infantryman--he certainly is desperately vulnerable, but he is not yet obsolete. Tanks are a basic requirement as a part of the team until a better weapon to do the same job is found.

12. The Korean terrain is probably the least-suited to major tank tactics--yet tanks have been used to spearhead amost every successful infantry action, and infantry commanders are emphatic in insisting on their need for tank as well as air support. Each weapon can meet some particular enemy counter-weapon. In open country, the use of flanking and enveloping movements still appears to be one of the basic tasks of tanks.

13. In Figure 1, from the data in Table I, the relative frequency of occurrence of a given opening range is plotted for Korea

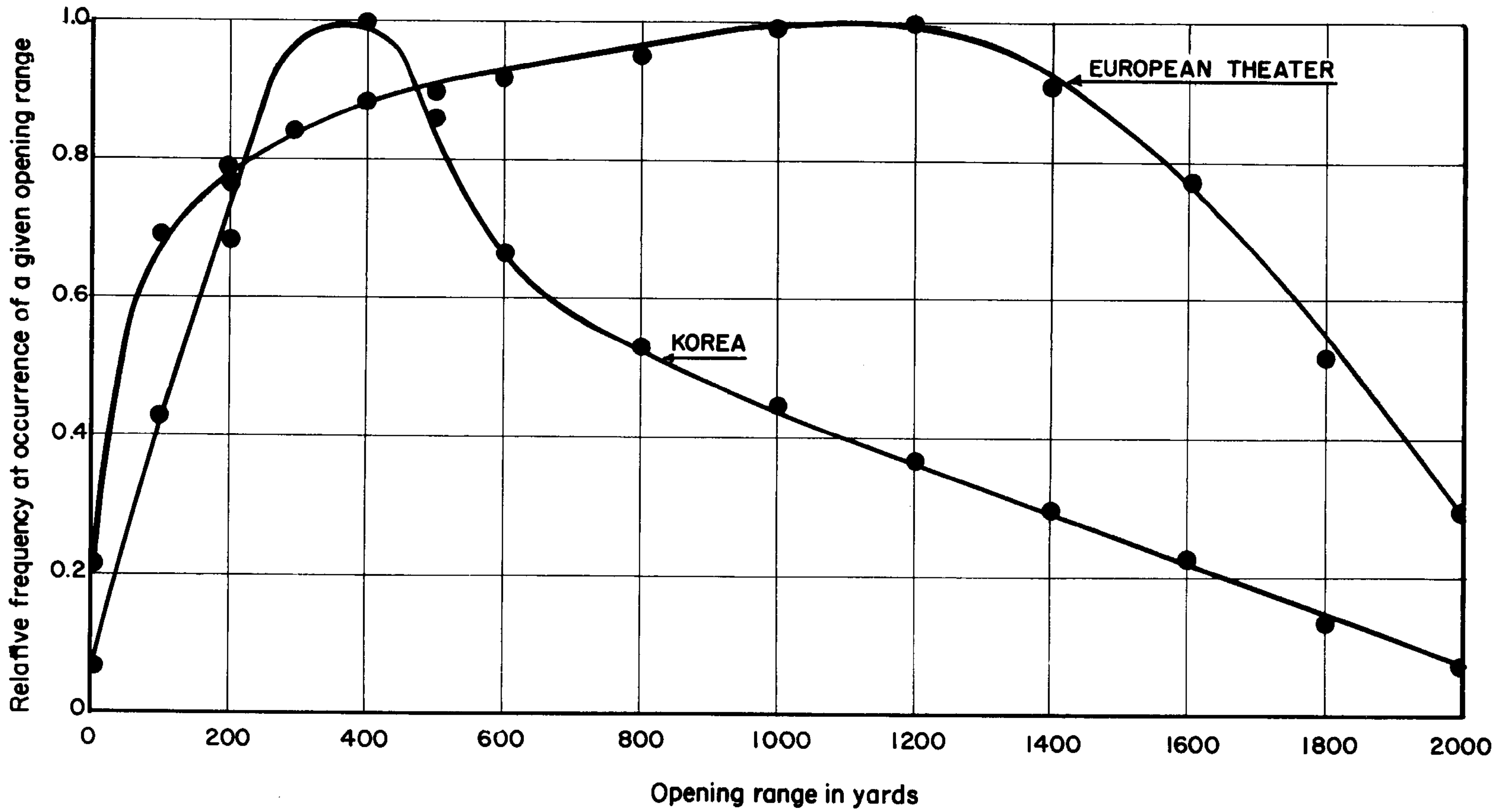


Figure 1.--Relative frequency of occurrence of a given opening range.

APPENDIX A

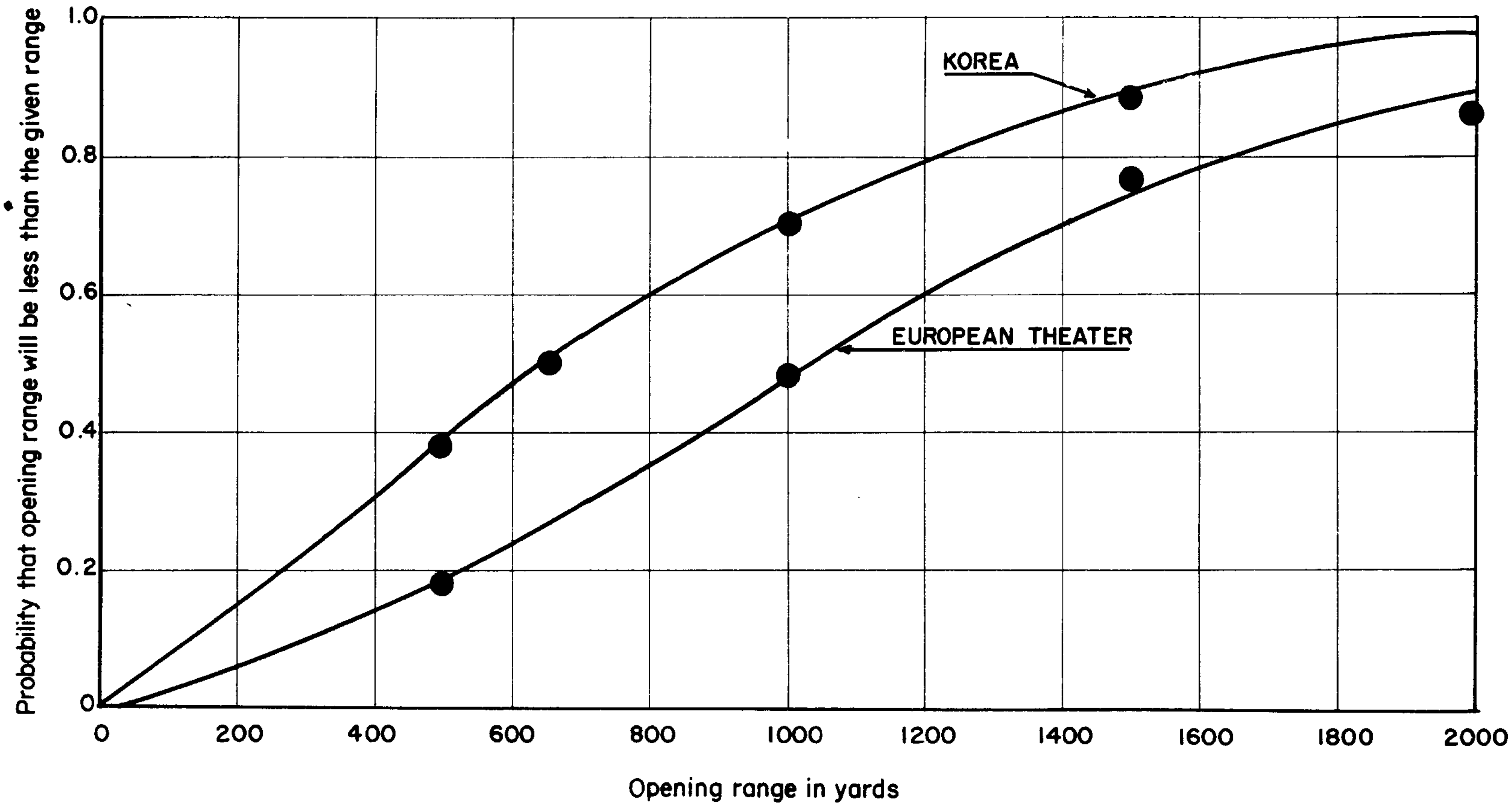


Figure 2.--Probability that the opening range will be less than the given range.

and the European theater. From this curve Figure 2, which gives the probability that the opening range will be less than the given range, has been plotted. The shape of these curves is presumed from the effects of terrain, local cover, and friendly and enemy tactics. The unusual hump in the Korea curve of Figure 1 is assumed principally on the basis of terrain.

14. From Figure 2, 50 percent of opening ranges lie below 650 yards in Korea and 1,050 yards in ETO. If a 2 percent loss in possible kills is acceptable, then the required gun range against enemy tanks in Korea is 2,000 yards, but in ETO a gun range of 3,000 yards would be required.

15. From a general examination of US tanks, the Air Force Operations Analysis tests of napalm against T34 tanks (FEAF Operations Analysis Office Memo No. 27, prepared jointly with Deputy for Operational Engineering, FEAF, 30 October 1950) and the ORO tank survey (see Appendix K), it is believed that napalm-caused tank fires are essentially "accidental" in nature, i.e., the napalm itself does not have enough energy to set ammunition or fuel afire by heating a tank, but it does have enough effect to set afire rubber bogie wheels, which in turn can fire the tank bilge or ammunition and thus kill the tank. Also, napalm entering through the air intake of a tank can set the bilge afire, again firing ammunition and killing the tank. It appears that both of these "accidents" can be eliminated by minor tank redesign or by fire extinguishing techniques.

16. There were frequent comments on the inadequacy of information on the local and surrounding tactical situation. This indicates the need for some type of collation of all the information which bears on the combat of the battalion and regiment. Such information comes from patrols, agents, and air sources. For lack of collation, it is believed this intelligence is not adequately used. Collation in a Joint Intelligence Center could greatly assist command down to battalion level. The Center would be operated at army level, and would send flash information, maps, and photographs to corps, division, and regimental levels.

17. The lack of antiaircraft defense in Korea seems to have been a considered risk. There appears to be less excuse for lack of care and discipline in passive measures both in bivouac and on the march. Such measures, although time-consuming, should be followed as a precaution and as <u>essential basic training</u>. An unexpected air strike, unprepared for, could have a decisive effect against US forces.

CONCLUSIONS

The following tentative conclusions are derived from the opinions of the battalion and company commanders of US tank and infantry forces in Korea:

1. The tank-infantry-artillery-air team has been very effective in the Korean campaign in spite of the very difficult terrain.

2. This ground-air team has been much less effective than it should have been because of the gross neglect of joint training in both inter- and intra-service training during peacetime. Because of this neglect the ground commander has been forced to fight and train concurrently. This has unduly handicapped the ground commander.

3. All infantry commanders are emphatic in stating their need for light and medium tanks as a part of their teams.

4. The communications equipment for team communications has been inadequate.

5. The number of air-observer aircraft has been inadequate compared to the need.

6. Logistic support and repair for armor units, especially in spare parts and retrievers, has been highly inadequate.

7. Armor units are most vulnerable to infantry attack at night unless given very strong infantry protection while in night bivouac. Vulnerability can be greatly reduced by providing night vision or night illumination.

8. North Korean use of tanks as concealed artillery has been very poor since it has not used the basic mobility of armor and has made the tanks especially vulnerable to air attack.

9. The USSR may conclude on the basis of the Korean campaign that napalm is a very effective antitank weapon. This possible conclusion can be vitiated by minor redesign of US tanks to reduce effectiveness of "accidental" fires. In future attack on Soviet-manufactured tanks, napalm may remain effective, but the types of fluid filler--such as "G" agents, chlorine trifluoride, or pronock--in improved napalm-type tanks may be even more effective.

RECOMMENDATIONS

1. Intensive training of infantry-tank-air teams should be instituted in the ZI immediately as a part of ground training.

2. The US should, on a very high priority, develop the use of mines laid in statistical patterns and capable of killing tanks.

3. The Signal Corps should, on high priority, develop communications equipment suitable for ground-air team communications.

4. Consideration should be given to establishing a Joint

Intelligence Center to aid in directing ground-air team combat.

5. A statistical control procedure should be developed to provide adequate records of armor combat. This could be maintained by personnel already assigned to tank battalions.

6. US tank tactics should emphasize movement and should use armor divisions as well as small tank groups locally assigned to infantry.

7. Infra-red vision or night illumination for tanks should be given high priority in development.

8. US infantry should develop tactics for night attack on enemy tanks since this is the period when tanks are most vulnerable.

9. Passive defense against air attack should be maintained as a training measure even during periods of low risk. An armor interval of 100 yards in bivouac and 50 yards on the march is suggested.

10. A program to reduce vulnerability of US tanks to fire from attack by napalm or new fillers in napalm-type bombs should be given high priority.

11. Three or more L-5 aircraft with personnel and maintenance requirements should be assigned to each tank battalion.

APPENDIX B

EMPLOYMENT OF ARMOR IN X CORPS

Introduction

Between 19 December and 3 January all X Corps armor units were visited by Mr. H. W. MacDonald and Capt. E. D. Strong of ORO. The units consisted of: 1st Tank Battalion, 1st Marine Division, at Masan; Regimental antitank platoons of 1st, 5th, and 7th Marine Regiments, at Masan; 73rd Tank Battalion, 7th Division, at Pusan; 31st and 32nd Regimental Tank Companies, 7th Division, at Pusan; 64th Tank Battalion, 3rd Division, at Ulsan; Tank Company, 17th Infantry Regiment, 7th Division, at Sinnyong; 7th Reconnaissance Company, 7th Division, near Ingo-dong; 3rd Reconnaissance Company, 3rd Division, at Madong-ni; Tank Company, 7th Infantry Regiment, 3rd Division, near Oil-li; and Tank Company, 65th Infantry Regiment, 3rd Division, near Yongjong-ni. In addition, the Headquarters of the 3rd and 7th Infantry Divisions, and of X Corps, were visited. These were located at Madong-ni, Yongchon, and Kyongju respectively.

In this survey, battalion commanding officers and their staffs, company, platoon, and in most cases tank commanders, as well as maintenance, supply, and communications personnel were interviewed. Cooperation was excellent at all levels. This survey covers mainly the period from the landing at Inchon on 15 September to the departure of the 3rd Division from Hamhung on 24 December, but includes also the previous activities of Company A, 1st Marine Tank Battalion, which landed with the Provisional Marine Brigade at Pusan in early August, and the 73rd Tank Battalion, which landed on 7 August.

Original Composition of Units

1st Tk Bn (Mar): 4 co's of M26's (17 M26's, 3 M4A3 dozers, and 1 M32 retriever in each) and 1 flame plat (9 M4A3's with 105-mm howitzers).
Regimental AT plats of 1st, 5th, 7th Mar Regt's: 5 M26's in each.
73rd Tk Bn: 3 co's of M26's (22 M26's, 3 M4A3 dozers, and 1 M32 in each).
31st, 32nd, 17th Tk Co's: 22 M4A3's and 1 M32 in each.
7th Recon Co: 7 M4A3's.

ORIGINAL COMPOSITION OF UNITS

64th Tk Bn: 3 co's of M46's (22 M46's, 3 M4A3 dozers, and 1 M32 in each).
7th, 15th, 65th Tk Co's: 22 M4A3's and 1 M32 in each.
3rd Recon Co: 7 M24's.
TOTAL: 416

Employment of Tanks

Although tanks were employed mainly in the infantry-support role in both of the principal X Corps operations (following the Inchon and Wonsan landings), the two operations differed markedly. This was because of the different weapons and tactics employed by the enemy in each case, and the changed tactical disposition of the UN forces. South of the 38th parallel our armor was opposed by enemy tanks, self-propelled and towed antitank guns, and fairly extensive minefields, whereas in northeast Korea enemy armor was completely absent, and only a few small-calibre antitank guns were encountered. Our armor was, however, opposed by aggressive infantry who used a large volume of small-arms fire, mortars, captured bazookas, and satchel charges. Tank units were widely dispersed over a very difficult mountainous terrain, often far from supporting maintenance and supply units. They were used for spearheading infantry attacks, convoy escort, road reconnaissance, guarding regimental CP's, and for covering the rearguard during withdrawal. The tanks covered long distances in road marches, and the combination of icy surfaces, sharp curves, and severe gradients accounted for many tank casualties. Tanks were abandoned which could have been salvaged had spare parts and repair facilities been available.

The tank units with the 1st Marine and 7th Divisions were landed at Inchon and took part in the fight for Seoul. Previous to this, Company A of the Marine tank battalion had been in action on the Masan and Naktong River fronts, and the 73rd Tank Battalion, which had been in army reserve, had been employed in antiguerrilla and MSR defense; Company C of the 73rd Tank Battalion was attached to the 27th RCT in the Tabu-dong area. These units were then shipped by sea to the east coast, and were later joined by the 3rd Division. The 64th Tank Battalion landed at Wonsan on 19 November, and operated between Wonsan and Hamhung. The 73rd Tank Battalion remained in reserve in the Hamhung area. Companies B and D of the 1st Marine Battalion and Tank Company, 31st Infantry were in the vicinity of the Chosin Reservoir. The 7th Reconnaissance Company and Tank Company, 17th Infantry went up to Hyesanjin on the Yalu River. Companies A and C of the 1st Tank Battalion and Tank Company, 32nd Infantry remained in the vicinity of Hamhung. The regimental companies of the 3rd Division were employed between Singosan, which is 20 miles south of Wonsan, and Oro-ri, which is 13 miles northeast of Hamhung, mostly within 15 miles of the coast. Those tanks in the Chosin Reservoir and Hyesanjin areas were heavily engaged in the withdrawal to Hamhung. All tank units were evacuated by sea from Hamhung, and were landed at Pusan and Ulsan.

Trafficability

Movement of tanks was generally confined to the roads. The roads are of rough but heavy construction and have crushed stone bases. Roads, except in mountain areas, are built from 5 to 20 feet above ground level and have 45 to 60 degree shoulders. Mountain roads are narrow and winding, with many sharp curves and steep grades, and have no guard rails or fences of any kind. In many instances bridges of insufficient strength had to be bypassed which was generally not difficult in the south. But bypassing often presented formidable problems in the north, where ravines and and gorges of considerable depth had to be crossed. Unfrozen rice paddies could be crossed where there was a firm bottom a foot or so below the sludge, provided that the tanks were not steered in the paddies, but prior reconnaissance on foot was necessary to determine the depth of the sludge. Tanks could go from one paddy to another if the intervening dikes were not more than 2 to 3 feet high; higher than this, the tanks would dig in, become mired, and often throw their tracks. The rice paddies could be traversed when frozen provided the tanks did not follow in each others tracks, which might cause the solid surface to give away. In an attack demonstration, one M26 managed to climb a 2,000-foot, 30-degree slope consisting of terraced unfrozen rice paddies, but the tank threw both tracks making a slow turn near the top.

In the north, light snow and considerable ice were encountered; these caused tanks much traction trouble. Tanks equipped with the T81 and chevron-type steel tracks had great difficulty with skidding and sliding, particularly when trying to negotiate bends. Tanks sometimes kept one track in the shallow ditches of the mountain roads to insure staying on the road. The Tank Company of the 17th Infantry, in a road march from Chori to Pungsan, climbed 4,600 feet in 11 miles, with many deep bypasses of 50 to 500 feet. The first tank took two and one-half days to make this trip. Another platoon of the same company had to shovel ice and snow off the road in order to negotiate a mountain pass. The 3rd Reconnaissance Company, with rubber-tracked M24's, found the performance of these vehicles on ice and snow much better than steel tracked vehicles such as the M39. All units had to be careful to prevent an accumulation of frozen mud and snow behind the drive sprocket, which caused many tracks to be thrown.

Tank Casualties

Table I shows the tank casualties sustained by X Corps up to 1 January 1951. (See Annex 1 for a unit-by-unit breakdown of X Corps casualties.) A few of these casualties were sustained by Company A, 1st Tank Battalion before it became a part of X Corps. The greater part of the casualties occurred in northeast Korea, the casualties of the X Corps prior to the landing at Wonsan being 67, of which 7 were total losses; there were 86 casualties in the period following this landing, of which 50 were total losses.

TANK CASUALTIES

TABLE I

X CORPS TANK CASUALTIES

UP TO 1 JANUARY 1951

(Figures in parentheses indicate total losses)

Cause	Prior to Wonsan Landing	After Wonsan Landing
Mech failure	46 (1)	54 (26)
Tank fire	4 (2)	0
Infantry attack	0	3 (3)
Terrain	3 (1)	17 (17)
Mines	9 (1)	1 (1)
AT guns	4 (2)	3 (3)
Mortars	1 (0)	2 (0)
Tactical abandonment	0	6
TOTAL	67 (7)	86 (50)

These figures show the different conditions which confronted tank units in the two areas. In south Korea, 10 percent of the tank casualties became total losses; in northeast Korea, 65 percent were total losses. This was caused by lack of spare parts, the great distances separating many tank units from their ordnance supporting units, and the tactical situation. Many units could have recovered, repaired, or evacuated tanks had sufficient time been available. Many of the terrain losses, a large item, could likewise have been recovered. It is noteworthy that only one mine casualty occurred in northeast Korea, and that only seven of the losses resulted from direct enemy action. The 100 cases of mechanical failure reported are broken down in Table II.

TABLE II
BREAKDOWN OF MECHANICAL FAILURES

Source of Mech Failure	Number
Engine	27
Transmission	20
Engine accessories	15
Tracks and final drive	11
Fair wear and tear	10
Gun	5
Freezing	3
Accidental flooding	3
Electrical	3
Turret	2
Brake	1

The total tank strength of X Corps was 416, and in the period covered there was a total of 153 casualties (37 percent) of which 63 (15 percent) were total losses. The number of personnel casualties from all causes was small, less than 100, with very few killed. More crew members became casualties when dismounted or exposed while firing the cal .50 machine gun mounted on the turret than when inside the tank. The tank units also suffered as many casualties from road accidents and frostbite as from actual battle casualties.

Tank-Infantry Teamwork

Tanks were mainly used in support of infantry, on the basis of one platoon of tanks to one battalion of infantry. As indicated in previous armor studies, the lack of combined tank-infantry training resulted in an initially poor appreciation of each other's limitations and capabilities. Tank units generally operated under infantry command, often were not given adequate information as to the mission they were required to accomplish, or sufficient time after briefing to make a reconnaissance or to issue orders to the tank commanders. The infantry frequently wished to commit tanks to attack up hills with them, whereas the tank commanders felt that, owing to the rough terrain and the difficulty of depressing guns sufficiently on many slopes, they could give better supporting fire from below.

One of the most frequent complaints of tank commanders was that theinfantry, when stopped by small-arms fire, failed to tell the tanks, either on radio or tank telephone, where it was coming from. In such circumstances tanks often failed to see or hear the weapons stopping the infantry. Another cause of difficulty was that, after using tanks all day, at night the infantry would place tanks in blocking positions to cover likely enemy approaches instead of sending them back to an assembly area for refueling, rearming, and maintenance. Infantry failed to appreciate that refueling, rearming a platoon takes a considerable time, particularly under blackout conditions at the front, and without daily preventive maintenance tanks used in sustained operations will soon fail mechanically. Tanks were sometimes used at night without infantry support to cover gaps in the line, and many tank crews stressed the need for a night vision device.

During the withdrawal to Hamhung, the infantry on a number of occasions independently fell back at night without coordinating with the tank units, and the result was that tanks were subjected to close-quarter attack by enemy infantry. The means of attack in such cases was to pour a large volume of small-arms fire on the tanks, knocking out periscopes, antenna bases, and external fixtures. Sometimes bazookas and antitank rifles were used in addition. The infantry would then attempt to overrun the tanks and knock them out by placing satchel and pole charges and grenades in the tracks and engine compartments. Tanks had to give each

other mutual support on these occasions, and even when our infantry were present they were often neutralized by the volume of enemy small-arms fire. Although much minor damage was done to the tanks, only three were lost to infantry attacks, and heavy casualties were inflicted on enemy infantry during these night actions. Units stated that there was less inclination on the part of the enemy to press home an attack when tanks were present. For use of the main armament against personnel, tank units would have liked more WP ammunition and also a canister type of ammunition. The blast from the 90-mm gun, deflected to the sides by the muzzle brake, has injured supporting infantry, who had not been trained to avoid it, on several occasions.

Tank-infantry communications have varied considerably from unit to unit. In general the AN/VRC-3 has performed satisfactorily, but has not been used sufficiently by some infantry units. The tank-infantry telephone has been an effective means of communication when properly employed, although in certain cases infantry appeared to be unaware of its existence. The installation on the M26 was not satisfactory as the box was hard to open, and in operation there were many instances of the phone not being replaced properly. This led to the tank intercom system being put out of operation, and to the phone falling on the ground and becoming damaged. It was generally reported that communications were inadequate between the tank battalion and companies, partly owing to the mountainous terrain and the distances involved. The 508 radio has not sufficient range for this purpose. To maintain contact with all elements of the division, including air and artillery, the 1st Tank Battalion of the 1st Marine Division fitted a M4 tank as a mobile communications center. This tank, called the "Porcupine," performed very effectively, particularly in ground-air communications. It was equipped with both portable and nonportable sets. The portable sets were the following: MAW, ANGRC-9, SCR-300, 510, and 610. The nonportable sets were the following: 191 and 312, 542, 508, 608, and BC-1000.

Operation of Tanks in Cold Weather

The minimum temperatures encountered by tanks of the X Corps during their operations in northeast Korea were between -25 and -30°F. On the whole, it may be said that they operated better than might have been expected for tanks which had not been winterized. The principal difficulty, which has already been mentioned, was the lack of traction on icy surfaces. However, the units which experienced these extreme temperatures reported the following additional difficulties:

1. Periscopes frosted when "buttoned up."

2. Gun solenoids froze and weapons had to be hand-fired.

3. Engine starters became inoperative.

4. Auxiliary generators were difficult to start.

5. Batteries discharged more rapidly than usual.

6. Guns failed to extract when firing the first two to three rounds.

7. Elevating and traversing mechanism became stiff and difficult to operate.

8. Recoil mechanism was slow in returning gun to battery on first few rounds.

9. Machine guns failed to operate because lubricants froze in both guns and links.

10. Fuel pumps froze because of water in fuel.

11. Radiator caps permitted loss of coolant.

12. Instrument light batteries failed.

13. Microphone diaphragms and buttons froze.

When the starters and batteries of the tanks were in good condition, no particular difficulty was reported in starting the tank engines. Some units, if sufficient fuel was available, attempted to keep their engines warm by starting every one and a half to two hours, but this was not a general practice. Several units had great difficulty in obtaining adequate supplies of anti-freeze and in one particular case two tank companies were forced to use diesel oil as a substitute.

It was complained generally that tanks were difficult to man in extremely cold weather. The tanks heaters provided were totally inadequate. The situation was worsened when the blowers were in operation, owing to the introduction of cold air into the crew compartment. The tank crews were unable to operate efficiently when wearing heavy gloves, shoepacs, parkas, and the standard clothing issue. A less bulky type of clothing for tank crews is required for cold weather operation.

Many of the mechanical difficulties previously listed were caused in part by the lack of proper cold-weather lubricants. It was apparent in this investigation that as the temperature decreased, the maintenance requirements of the tanks mounted. At the same time, the problem of proper maintenance was increased greatly because of the difficulty of working with cold metal parts.

Maintenance and Logistic Support

The tank units of the X Corps were largely dependent upon

their own resources for the tank maintenance. Ordnance maintenance units at division level or higher were unable to give the required support for three reasons:

1. Lack of spare parts.

2. Lack of qualified tank mechanics. This shortage extended down to company level.

3. The distance factor. Ordnance units were too far to the rear to render proper ordnance service.

The first time most of the units received adequate support from ordnance companies was while passing through Pusan after the evacuation from Hamhung. It was very evident that in this operation the divisional ordnance company was unable to give much assistance to either the division tank battalion or the regimental tank companies. The tank mechanics and the tools and equipment provided to the regimental service company for supporting the tank company have been employed principally for general motor vehicle maintenance within the regiment. As a result, the regimental tank companies, without the backing of a battalion organization and its maintenance facilities, experienced great difficulties in keeping their tanks in operation.

The spare part supply situation for the M4 and M26 tanks was particularly critical and cannibalization had to be resorted to rather generally. Units including division ordnance did not have anything near their full basic load of spare parts. This situation was aggravated because many of the tanks brought to Korea had seen extensive service elsewhere or had deteriorated while in storage. One battalion with M26 tanks departed the US with all but 10 to 12 tanks in unsatisfactory operating condition. These tanks, in operation since 1946 in troop training, were in serious need of complete overhaul. As an example of the spare parts situation, Annex 2 presents a list of parts received by one tank battalion from the time of their departure from the US in early August to 24 December 1950.

A more powerful recovery vehicle than the M32 is needed to deal with disabled M26 and M46 tanks. The M39 with its trailer has not been satisfactory as a maintenance vehicle in Korea as it lacks sufficient stowage and does not permit the maintenance mechanics to work in the vehicle under cover or at night. A number of tank units have expressed a preference for a 6x6 general purpose truck that could be outfitted as a maintenance and spare parts vehicle. Supplies of tools were deficient in most units, and many of the tools available, particularly the 1¼-in and 15/16-in socket wrenches, were not robust enough for the heavy duty requirements of tank maintenance.

With regard to the logistic question, no critical shortages

of fuel or ammunition occurred except at Hagaru-ri when the enemy cut the MSR. However, with the transport available, the tank units frequently had considerable difficulty in replenishing themselves with fuel and ammunition in combat. The 1st Tank Battalion, 1st Marine Division found that, with three of its four companies committed to an active day's combat, approximately 140 tons of fuel and ammunition were required daily in the Inchon-Seoul operation. The thirty-four 2½-ton cargo trucks assigned were insufficient under such circumstances and it was considered that 60 trucks would be necessary. Because additional transportation has not been authorized, the higher fuel consumption of the M46 (4.5 gallons per mile) has introduced a special logistic problem in units equipped with this tank.

Several of the regimental tank companies did not get proper support from the regimental service company, for the 10 trucks assigned to the service company for the logistic support of the tank company were used for other purposes. The infantry regimental staff did not appreciate the weight and volume of supplies necessary to keep a tank in operation.

Refueling of tanks from 55-gallon drums has been fairly common in Korea. Inasmuch as the tank units are equipped to refuel with 5-gallon containers, some difficulty has been reported in handling the larger container.

Crew Recommendations

Previous mention has been made of the tank features that have proven weak in the service encountered in Korea. Representatives of the Ordnance Corps have already noted and dealt with the mechanical corrections found necessary in the M46. Many of the deficiencies reported in older tank models have already been corrected in the newer models. However, a number of recommendations with regard to tank design and equipment have been made by personnel of tank units; these are worthy of mention and consideration.

1. Because of the volume of small-arms fire, many antenna bases have been destroyed, and some protection against small-arms fire is necessary.

2. Road wheel hubs have frequently been hit by small-arms fire with a resultant loss of the lubricant. A hub sufficiently strong to resist small-arms fire is necessary.

3. Oil, water, rations, and personal gear stowed on the outside of tank have been repeatedly destroyed by small-arms fire, and some internal storage would be desirable.

4. Tank crews would prefer a cal .50 coaxial gun, and the bow gun should have sighting equipment, and greater elevation and traverse.

5. To avoid exposing crew members, a method of closing hatches from the interior of the tank is desired.

6. Hand rails should be welded to the turret for the use of infantry riding on the tank.

7. A light false deck over the engine louvers on the M46 is recommended to protect infantry from the heat while being carried and to prevent dirt entering the engine compartment.

8. Tow cables, hooks, and pintles are too light.

9. Special clothing for tank crews is necessary. The present infantry-type winter clothing is too bulky and is easily snared on the apparatus of the tank. A return to some form of the old tank-combat suit would be welcomed.

10. Tank dozers wear out front bogies rapidly owing to the concentration of weight at the front. A redesign of the suspension is suggested.

11. The brass disc-type oil filter has not been satisfactory where used, and a mesh-type filter from ¼-ton trucks has been substituted satisfactorily.

12. Tank commanders should be provided with a simplified form of engineer bridge card to enable them to make reasonable estimates of bridge capacities.

13. Some method should be provided for steering the M46 when it is being towed with the engine not running.

14. There was general dissatisfaction with the present type of earphones. A phone is desired that has more comfortable earpieces, fits close to the head, and still permits wearing of the helmet. A one-earphone headpiece has also been suggested to enable the wearer to hear external sounds.

15. External ammunition racks should be provided for use by the supporting infantry.

16. For greater protection of periscopes against small-arms fire, a metal plate backing should be provided.

17. Inspection plates should be flush with the surface of the tank belly.

18. The lack of a hatch on the M32's turret has caused casualties among maintenance personnel.

19. On the M26, fumes from the tank gun accumulating in the fighting compartment caused crew fatigue, and in a sustained

action caused nausea and fainting. The tanks equipped with evacuators did not experience nearly as much trouble, but further improvement could be made.

APPENDIX B, ANNEX 1

UNIT BREAKDOWN OF X CORPS CASUALTIES UP TO 1 JANUARY 1951
(Figures in parentheses indicate total losses)

Division	Unit	Mech Failure	Tk Fire	Inf Attk	Ter-rain	Mines	AT Guns	Mor-tars	Tac Aban-donment	Evac-uated	Re-placed
1st Marine Div	Hq 1st Tk Bn										
	Co "A,"1st Tk Bn	4 (0)	- -	- -	1 (1)	- -	2 (2)	- -	1	4	8
	Co "B,"1st Tk Bn	1 (1)	- -	3 (3)	1 (0)	2 (0)	1 (0)	2 (0)	5	1	1
	Co "C,"1st Tk Bn	- -	- -	- -	- -	2 (1)	- -	- -	-	-	-
	Co "D,"1st Tk Bn	9 (7)	- -	- -	- -	3 (0)	1 (0)[a]	- -	-	2	2
	Tk plat,1st Mar	3 (0)	- -	- -	- -	- -	- -	- -	-	3	3
	Tk plat, 5th Mar	1 (1)	- -	- -	- -	- -	- -	- -	-	-	-
	Tk plat, 7th Mar	- -	- -	- -	- -	- -	- -	- -	-	-	-
	Flame plat,1st Mar	- -	1 (0)	- -	- -	- -	- -	- -	-	1	1
7th Inf Div	Hq 73rd Tk Bn	4 (0)	- -	- -	- -	- -	- -	- -	-	-	-
	Co "A"	14 (0)	- -	- -	1 (0)	2 (0)	- -	- -	-	7	7
	Co "B"	8 (0)	1 (1)	- -	- -	- -	- -	- -	-	5	5
	Co "C"	18 (0)	- -	- -	- -	- -	- -	1 (0)	-	4	4
	Tk Co,31st Inf	2 (2)	2 (1)	- -	6 (6)	- -	2 (2)[b]	- -	-	-	2
	Tk Co,32d Inf	2 (0)	- -	- -	- -	- -	- -	- -	-	2	2
	Tk Co,17th Inf	14 (9)	- -	- -	1 (1)	- -	- -	- -	-	7	4
	7th Recon Co	2 (2)	- -	- -	- -	- -	- -	- -	-	5[c]	4
3rd Inf Div	Hq 64th Tk Bn	4 (4)	- -	- -	- -	- -	- -	- -	-	-	-
	Co "A"	6 (0)	- -	- -	2 (2)[e]	- -	- -	- -	-	6[d]	-
	Co "B"	- -	- -	- -	1 (1)	- -	- -	- -	-	-	-
	Co "C"	1 (1)[f]	- -	- -	- -	- -	- -	- -	-	-	-
	Tk Co, 7th Inf	1 (0)	- -	- -	5 (5)	- -	- -	- -	-	1[d]	-
	Tk Co, 15th Inf	2 (0)	- -	- -	1 (1)	1 (1)	1 (1)[g]	- -	-	2	3
	Tk Co, 65th Inf	2 (0)	- -	- -	1 (1)	- -	- -	- -	-	2[h]	-
	3rd Recon Co	2 (0)	- -	- -	- -	- -	- -	- -	-	2	-
	TOTALS:	100 (27)	4 (2)	3 (3)	20 (18)	10 (2)	7 (5)	3 (0)	6	54	46

Total losses from all causes:--63. Total casualties from all causes:--153.

(a) Believed to be 2.36-in bazooka; (b) 1 lost to bazooka; (c) 2 tanks evacuated to ordnance and destroyed; (d) Evacuated tanks to be returned; (e) Bridge failure; (f) Parking brake failure, rolled off ship to dock; (g) Evacuated tank to be returned; (h) Bazooka through engine compartment; (h) Evacuated tanks to be replaced.

APPENDIX B, ANNEX 2

SPARE PARTS FOR TANKS RECEIVED BY

1ST TANK BATTALION (MARINES) IN KOREA

M4A3

Stock Number	Ord. No.	Nomenclature	Qty
G104-26-93201		GENERATOR, w/pulley assy (24 volt) each	3
	C124412B	MAGNETO, left, assy (anti-clockwise) (type MJF-4B-315)	4
C12	C124412A	MAGNETO, right, assy (clock-wise) (type MJF-4B-316)	3
G104-15-31735	D66321	CARBURETOR, assy (Bendix-Stromberg) (NA-YSG)	1
G104-16-61001	A303343	KIT, repair, carburetor	2
G104-16-61002		KIT, repair, fuel pump	4
G104-17-45835	C124361	PUMP, fuel, assy	6
G104-22-02302	C124379	GOVERNOR, complete, assy	1
	B258373	HEAD, engine cylinder w/ camshaft assy, left, w/head assy A411706	1
	B296678	HEAD, engine cylinder w/ camshaft assy, right, w/head assy, A411707	1

M26

Stock Number	Ord. No.	Nomenclature	Qty
G197-7058790	7058790	CARBURETOR, main engine front, assy (Bendix-Stromberg type HH5)	2
G197-7058791	7058971	CARBURETOR, main engine rear, assy (Bendix-Stromberg type HH5)	1
G104-1439451	B264103	DEGASSER, engine carburetor, left, assy	1
G197-5624409	C124409	GOVERNOR, engine assy, ea	1
G999-621004	B210146	ELEMENT, fuel filter	1
G104-3142300	A297237	UNIT, sending water temperature (on right water manifold)	1

ANNEX 2

SPARE PARTS FOR TANKS RECEIVED BY
1ST TANK BATTALION (MARINES) IN KOREA (continued)

Stock Number	Ord. No.	Nomenclature	Qty
G226-7021505	7021505	GENERATOR, w/regulator comp assy	2
G104-1847818	A296647C	CABLE, ignition, high tension, 35-1/2" long, cylinder no. 1 left	2
G104-1847815	A296647A	CABLE, ignition, high tension, 41" long, cylinder no. 2 left	1
G104-1847816	A296647B	CABLE, ignition, high tension 46" long, cylinder no. 3 left	2
G170-0139946	A296645B	CABLE, ignition high tension 53-1/2" long, cylinder no. 4 left and right	1
	707103	TRACK, rubber (T80E1) (used w/sprocket D47366) (optional w/track T84#1)	40

APPENDIX C

TACTICS OF ARMOR-INFANTRY-ARTILLERY IN THE KOREAN THEATER

SCOPE

This report is of a definitely limited nature. The investigation of the information and material available was of necessity confined to the war diaries of the 24th Infantry Division and its organic units--the 21st, 19th, and 34th Regiments, and later the 5th Infantry Regiment--from 2 July to 28 September 1950, plus occasional units from other divisions that were attached from time to time. Consultation with combat personnel and unit commanders, which would have been the logical next step, was impractical because of the tactical situation at the time this report was written (5 December 1950). The war diaries of other combat units of the Eighth Army in action against the North Koreans during this period (the 25th and 2nd Infantry Divisions and the 1st Cavalry Division) were either not available or were too incomplete to be of value. Hence the information contained herein cannot be construed as either complete or conclusive. However, it seems reasonable to consider the experience and performance of the 24th Infantry Division as fairly typical of the other combat divisions of the Eighth Army, since all were essentially similar in composition and equipment and operated over the same terrain against a common enemy.

PURPOSE

The purpose of this report was to obtain if possible a clear picture of the tactics and methods employed by various combat elements, regimental combat teams, small task forces, battalions, companies, and platoons in both offensive and defensive action in the utilization of their armor, infantry, and artillery components. Inasmuch as tactical air support was frequently an additional factor in ground combat operations, (a factor covered in detail in ORO-R-3, FEC), this particular study has endeavored to confine itself to those operations where air support, from the available evidence, was either not employed or not available. As a consequence, the number of case studies meeting these specifications are comparatively few, and the purpose of the investigation could not be accomplished to the degree desired.

DISCUSSION

DISCUSSION

US Defensive Operations

Enemy Tactics. The offensive tactics employed by the North Koreans in the first months of the campaign followed a very consistent pattern. They were equipped with an ample supply of armor, self-propelled and wheeled artillery, and infantry mortars. Their troops demonstrated a high degree of training for the type of operation in which they were employed. The individual soldier was physically strong, had great endurance, and was exceedingly aggressive in an attack.

In the retrograde movement of the US forces during July and early August 1950, the enemy repeatedly carried out well-planned and well-executed attacks. It was their practice to make an initial frontal attack with tanks and infantry to pin down our forces, whereupon an envelopment was made of one or both flanks or troops were infiltrated to the rear through gaps in the line. In this fashion, infantry units, artillery batteries, command posts, and supply points were repeatedly surrounded and overrun. In the case of the 24th Division alone, incidents of this nature occurred at Oson, Chonan, Kyongju, and Taejon with very grave losses of men and equipment (see References 1 and 2). Whenever our positions were penetrated to the front or rear, the enemy would endeavor to push small armored units to the rear to search out and destroy our close-support weapons and armor. In some cases, tanks were employed to make the initial thrust to be followed after an interval of 10 to 40 minutes by infantry (see Reference 3). Occasionally, when sufficient troops were available, attacks were made without artillery preparation or tank support in an effort to overwhelm our positions by sheer weight of numbers.

US Tactics in Defense. In the retrograde movement, the 24th Division, along with other units, was confronted with a situation which practically defied solution. The enemy was greatly superior in numbers and capable of exploiting the terrain with his highly mobile but lightly equipped infantry. On the other hand, the US forces were required to defend long fronts with completely insufficient numbers of troops. For example, the 24th Division in its defensive positions along the Naktong River was called upon to hold more than 43 miles of front with three badly depleted infantry regiments of but two battalions each (see Reference 4).

It was therefore necessary to evolve tactics that would provide some measure of effective defense, exploit to the maximum the heavy infantry-artillery-armor fire power which could be delivered by our units, and avoid exposing these units to destruction in detail by envelopment or infiltration.

Three types of defensive tactics were used by the 24th Division with considerable success, and it is believed by those who employed them that these tactics in combination with each other were instrumental in stopping the enemy's offensive even though he still retained numerical superiority.

The first method, which was applicable to the regiment and smaller units, consisted of placing the companies and battalions in column one behind the other, usually along the main road or supply route, with a distance between units ranging from 1,000 to 2,000 yards. The flanks on the hills were usually lightly held by small units. ROK troops, whenever available, were particularly useful in performing this function. Armor was usually distributed to provide close support of the main body and the flanks. Artillery was located to the rear to furnish covering fire over the entire area of action.

The North Koreans, employing their usual tactics of enveloping and infiltrating the flanks, found themselves not in our rear as they had expected but face-to-face with our main elements. Units that employed this maneuver seldom found it difficult to hold their position unless units withdrawing in neighboring sectors made their position untenable.

The second tactical procedure was applicable primarily to a division only. The front was lightly outposted with many small units of squad and platoon size. In the rear, held back to counterattack the enemy whenever he managed to penetrate the front, were large mobile reserves. This plan was quite effective provided enemy forces were not so numerous that all available units of the mobile reserve were committed. Even then, the enemy attacks were contained until aid could be provided by corps or army.

The third type of defensive tactics was perhaps more a matter of policy or conduct than tactics in the strict sense of the word. The Commanding General, Eighth Army, directed that US combat forces would exercise aggressive action at all times, maintain continuous contact with the enemy, and would counterattack whenever possible to prevent an increase of the enemy's strength and to force him to assume a defensive position. This kept the enemy deceived as to our true strength, enabled our forces to seize the initiative, forced the enemy off balance and raised the morale of the troops involved (see Reference 4).

US Offensive Operations. Tactics of the armor-infantry-artillery team kept the enemy deceived as to our true strength. When the US forces went over to a general offensive in September 1950, many of the tactical lessons learned during the defensive period were profitably applied. It had been shown earlier, in offensive operations of a local character by regimental combat teams and small task forces, that the enemy reaction to the advance of our forces might likely be quite light and the objective

of the attack rather easily attained. However, what was actually accomplished was not to push the enemy to his rear but to high ground on both flanks of our line of attack. This line of attack, because of the terrain and the inability of our armor and wheeled transport to operate cross-country, almost invariably consisted of a narrow, dirt road in a valley. Thus the enemy could and did sever the supply line to our attacking force. In some cases this necessitated a withdrawal from the objective and a fight back to the original line of departure, an action productive of serious casualties to personnel and armor (see Reference 5).

Therefore, when the general offensive began, the terrain and limited mobility of our vehicles channeled the line of advance to roads that had been mined by the enemy, damaged by our air interdiction, and over bridges, that had, almost without exception, suffered from demolition or air attacks. All had to be repaired as the forward movement progressed. The enemy thus had an excellent opportunity to employ his tactics of infiltrating to the rear to cut supply lines or to harass or destroy columns moving up behind the leading elements.

The US tactics of maneuvering in column of regiments, battalions, and companies which had been worked out while our forces were on the defensive was therefore carried over to the offensive. Here the closely coordinated armor-infantry team operating together was extremely successful not only at the point of the attack but as flank guards along the lines of the advance. In the crossing of the Naktong River (18-22 September) by the 24th Division, three separate crossings were made by regimental combat teams which, in a period of four days and against determined resistance, advanced in column via separate routes to capture Waegwan and strategic ground in the direction of Kumchon.

When the enemy was strongly entrenched and showed no inclination to either fall back or move out of his position to the flanks, as sometimes happened, two types of tactics were used with success. In the first, the lead RCT or battalion in column maintained a steady pressure on the enemy position while one of the units in column behind moved out in a wide enveloping maneuver to attack the flanks or rear. An example of this may be found in the operations of the 5th RCT and the 21st RCT in the attack on Kumchon 24-25 September 1950.

The second, again employing units in column, called for a continuous attack with the lead unit carrying the attack for a period of hours, at the end of which period the next unit to the rear would move up, pass through, and continue the action. This second attacking unit might in turn be succeeded by a third unit. The artillery and armor supporting this particular type of tactic usually would remain in position to work with each successive infantry element. Thus the enemy never was afforded an opportunity to rest or reorganize.

The command of the majority of the various armor-infantry-artillery team combinations which were employed to carry out the tactics just outlined appears to have been vested in the senior infantry officer in the team. However, an exception to this rule may be found in the case of Task Force Dolvin, 24-30 September 1950, in which a tank-infantry team was commanded by the senior armor officer. However, as it was operating with tactical air support, its tactics are not considered entirely suitable for the purposes of this report. Its composition, however, may be of interest. It was composed of two companies of M26 tanks, two companies of infantry, one platoon of engineers, one platoon from a heavy mortar company and the necessary medical and service elements. Its mission was to attack along the line of advance of the 25th Division, Hamyang-Namwon-Chonju-Kunsan. This task force was organized in the form of teams: one company of tanks joined with one company of infantry with the command of the team given to the tank company commander. The task force carried out a successful mission against a variety of enemy resistance and despite terrain difficulties.

CONCLUSIONS

Noting once again that the conclusions arrived at in this report must be qualified by the limitations of the investigation, it may be said that:

1. A closely coordinated infantry-armor team supported by adequate artillery was extremely effective against the North Koreans even when the enemy was numerically superior.

2. Training of combat troops must be based on developing a true appreciation of the capabilities and limitations of infantry, armor, and artillery so that these elements, when employed as a team, can be used most effectively.

3. Tanks in close support of infantry are a powerful morale factor for the infantry.

4. Medium tanks of the quality of the M46 have fulfilled the requirement of an infantry divisional tank in the Korean operations. It should be noted, however, that heavier and more powerful tanks probably will be required in the future.

5. Tanks that could safely move off the roads and negotiate the difficult terrain of Korea would have been of great value.

6. In the opinion of several combat unit commanders, the number of medium tanks (80) presently assigned to the divisional tank battalion was probably the maximum number that could be effectively employed, considering the terrain conditions. (It

should be noted that for the period covered by this study, the regimental tank companies of the 24th Division were for the most part not equipped.)

7. More effective communication equipment would be desirable so that contact between RCT's and task forces and higher headquarters would not be dependent, as it was on many occasions, on liaison aircraft. In addition, it has been suggested that a command intelligence center (CIC) be set up as an integral part of an infantry division to coordinate the operations of various elements.

8. While tanks and the 3.5-inch bazooka performed adequately as long- and short-range antitank weapons, antitank artillery imaginatively employed and skillfully concealed might have been a useful weapon in the infantry, particularly in a defensive operation.

9. Our infantry in particular was burdened with too much heavy equipment that was not essential and more light automatic weapons and mortars are needed. As of 15 September, the 24th Infantry Division was short about fifty 2½-ton trucks and a much larger number of ¼-ton trucks. The regimental commanders, however, considered this situation a help instead of a hindrance as it "caused the men to walk with their weapons in their hands firing at the enemy instead of riding and being fired upon."

RECOMMENDATIONS

1. This study should be continued, if and when the tactical situation in Korea permits, to develop the details, presently lacking, of the tactics of armor-artillery-infantry, by discussion with experienced unit commanders and by study of the terrain over which various actions took place.

2. An effort should be made by the Department of the Army to develop vehicles, both armored and transport, that will not force the combat units to confine their operations to roads, i.e., vehicles capable of greater cross-country mobility over terrain such as has been encountered in Korea.

3. Consideration should be given to the reintroduction of antitank artillery.

4. A review should be made of the divisional T/O&E equipment with the purpose of eliminating all nonessential items.

REFERENCES

1. War Diary and records:

a. 1st and 3rd Bn's, 34th Inf Regt, 6-7 July 1950 and 10-11 July 1950.

b. 21st Inf Regt, 17 July 1950.

2. War Diary and records:

   a. 63rd FA Bn, 14 July 1950.

   b. Hq, 24th Div Arty, 16 July 1950.

3. Narrative Summary, 24th Inf Div, 11-12 July 1950.

4. Narrative Summary, 24th Inf Div, August 1950.

5. 24th Inf Div Diary, Task Force Hill, 2 August 1950.

APPENDIX D

SUMMARY REPORT OF INTERROGATION OF 24 OFFICER PRISONERS-OF-WAR ON TANK WARFARE

by

H. W. MacDonald
and
E. D. Strong

1. Introduction:

a. Between 10 and 15 December, an ORO Interrogation team consisting of Captain E. D. Strong and Mr. H. W. MacDonald, with Kilchoon Kim as interpreter, interrogated twenty-four North-Korean Officer Prisoners-of-War located at Camp No. 2, near Tong-nae. The questionnaire used in the interrogation is appended along with copies of the complete record of the interrogation of each prisoner. All the officers in the prison camp who could be identified as having been assigned to North Korean tank units were included in the interrogation.

b. It was found that the particular specialties of these officers and their experience varied widely. The number of individuals with actual experience in tanks was very small, as apparently the casualties among such officers were extremely high. As a result, much of the useful information obtained in the interrogations was given by maintenance, signal and supply officers. See Table I.

TABLE I

DUTIES OF OFFICERS INTERROGATED

Duties	No. of Officers
Tank	9
Anti-Tank	1
Signal	1
Motorcycle	2
Tech	6
Supply	4
Culture	1

c. The officers fell roughly into two categories, those who were in the 105th Armored Division from its activation in 1948 and were Russian trained, and the replacements who came mainly from the 208th Training Regiment at Pyongyang and were assigned to the division and other armored units after the war began. These latter appeared, in most cases, to have less than a month's training. Consequently, the information that they could give was very limited. On the whole, most of them talked freely and gave information which, to the best of their knowledge, was accurate.

d. The level of intelligence, with one or two exceptions, was not high and it appeared that a small technical knowledge and the ability to read and write were sufficient qualifications to become an officer in the North Korean Armored Forces. The most senior officers interrogated were senior captains as no field grade officers of tank units were available.

2. Voluntary Surrenders and Captures:

a. Of the twenty-four officers interrogated, fourteen claimed to have surrendered voluntarily and ten admitted to being captured. Of the fourteen who surrendered, four claimed to have brought with them some of the men from their units. Two admitted that their decision to surrender was influenced by reading leaflets dropped by UN Forces. All the prisoners interrogated were captured between 3 September and 30 October 1950.

3. Causes of Tank Losses:

a. On the causes of tank losses, the actual figures were most conflicting and for the most part based on hearsay. The figures given by the prisoners for tank strengths and losses, particularly in the 105th Armored Division, appear to be very exaggerated. However, some indication of the relative effectiveness of various weapons employed by UN Forces in attacking armored vehicles can be obtained.

b. It is apparent that the majority of the tank losses suffered by the North Koreans were due to air attacks. It is apparent also that napalm was the most effective weapon used in air attacks, although six prisoners attributed rather high losses to rockets.

c. Insofar as ground fire was concerned, the prisoners were unable to distinguish clearly between tank and artillery fire. Very few were aware of the existence of the bazooka. The evidence that is available, however, points to tank fire as being extremely effective, penetrating the target tank on the first shot and almost invariably setting it on fire. Only one prisoner claimed that UN tanks failed to hit moving North Korean

tanks the first time, but required several shots before a hit was obtained.

d. With regard to mines, a technical officer of the 203rd regiment, 105th Armored Division, personally supervised repairs to ten tanks damaged by mines in his regiment, and a divisional technical officer repaired fifteen mine-damaged tanks in the 107th and 109th regiments. They claimed the damage was confined to the tracks and was easily repairable. There was no reliable evidence of a mine permanently disabling a North Korean tank.

e. Terrain and bad drivers accounted for a considerable number of the NK tank losses, because much of the movement of tanks took place at night and over inferior roads. The situation was aggravated by the complete lack of special recovery vehicles. Prisoners claimed that many of these mired or ditched tanks were later destroyed by air attacks.

f. Lack of fuel, cannibalization for spare parts, and mechanical failure also accounted for some losses but these losses apparently were not large.

g. Only one prisoner reported any cases of self-destruction of immobilized tanks.

4. Crew Casualties:

a. Crew casualties were very high when the tank armor was penetrated. Napalm air attacks often gave the tank crew sufficient time to abandon the tank before it was enveloped in flames. The presence of aircraft in the vicinity frequently warned the crew in time to abandon, before the attack was carried out. Consequently, the casualties from napalm attacks appear to have been light. One prisoner stated that many of those wounded among tank crews were hit by air strafing while abandoning their tanks after the air attack started.

b. One apparently reliable prisoner reported, in connection with tank accidents due to terrain and bad driving, rather heavy casualties among the crews. There is every indication from the interrogations that the over-all casualties among the North Korean tank units was extremely high with figures of 50 and 60 percent being mentioned.

5. Ammunition Carried in T-34:

The T-34 tank usually carried, according to the prisoners, 55 rounds of ammunition for the gun: 5 armor-piercing, 20 high-explosive and 30 anti-personnel. Owing to the critical ammunition supply situation, however, there were many cases reported of tank crews having to take whatever was available.

In addition the tanks were supplied with about 2000 rounds of M/G ammunition and 25 hand grenades.

6. Use of Tank Machine Guns:

The prisoners were practically unanimous with regard to the use of the tank machine guns. The guns were intended for attacking near-by enemy infantry. Very few knew of any use of the turret gun to designate a target. Several stated that the gun in the forward slope was seldom used.

7. Tactics:

a. When the North Korean Army crossed the 38th Parallel, their confidence in the striking-power and strength of their tanks was so high that they made no effort to conceal tank movements. In fact, according to some prisoners interrogated, they deliberately exposed the tanks to the view of the enemy to lower his morale. Their tanks preceded the infantry in some cases by a considerable distance. In other cases a squad or more of infantry was carried on the decks of the tanks. Owing to the heavy casualties suffered by tank-borne infantry, this practice, however, was largely discontinued after the fall of Seoul, although when the North Koreans were in retreat, tanks were used to carry infantry because of the lack of other transport.

b. Increasing air attacks after the 1st of July soon forced them to move only at night and to take rather elaborate camouflage measures during the day. The terrain of Korea restricted their operations largely to the main roads and they only used secondary roads and cross-country routes to by-pass demolitions or to seek a bivouac. Rice paddies were generally avoided.

c. When in bivouac during the advance to the south, the North Korean forces feared only air attack and consequently their security measures when in bivouac were not particularly rigid. Tanks were concealed in villages, orchards and at the foot of hills; sometimes, the tank was dug in to the side of the hill and covered with pine boughs. The concealment of tanks in villages was done by driving the tanks directly into a building, or parking close along side and extending the roof line over the tank.

d. In forward areas, where there was possibility of an attack on the bivouac, they would usually post one or two picket tanks about 1 or 2 kilometers to the front, along the main road, with either infantry or members of the tank crews outposted to the flanks. Often no proper security measures were taken, but one member of the crew usually stayed awake to guard the tank.

e. As previously stated, tanks frequently ran far ahead of the infantry, in attacks made in the early stages of

the campaign. Later, as the situation became more stabilized, tanks were kept back and were brought to the front lines at night prior to an attack. None of the prisoners knew of any measures taken to conceal engine noise when moving up to the attack position.

f. In answer to the question concerning flank and rear protection by infantry for North Korean tanks in combat, no standard procedure was indicated by the prisoners. In connection with the firing ranges in combat, the prisoners considered that the maximum effective range for AP was about 1400 meters but ordinarily they fired at about 800 meters.

8. Tank Performance:

a. With regard to the performance of the T-34, practically all of the prisoners were familiar with this tank only and had no means of comparing its performance with other tanks. They had been told, however, that it was at least the equal of any UN medium tank.

b. The prisoners' knowledge of the mechanical features of the tanks was very limited. However, the main mechanical failures that were reported were broken fans, and the steering system. Other difficulties were broken tracks, bad road wheel bearings, clutch trouble, and defects in the electrical system. The batteries in the T-34 were also a serious weakness as they required frequent attention and overhaul, with no replacements other than what could be obtained from disabled tanks.

c. Two types of radio sets were used in the T-34, the 9LS and the 12LDM. The former was the more common and better of the two, and the latter was primarily intended for use in self-propelled artillery. One brigade signal officer of better than average intelligence reported that the set was effective to 10 kilometers and was durable and reliable. However, many of the tank officers reported unsatisfactory radio communications, but blamed lack of knowledge in the use of the set on the part of the crew for the difficulty, rather than the set itself. The tank intercom system appears to have been uniformly satisfactory but the crews apparently preferred to use a touch-relay system for transmitting commands.

d. The full fuel capacity, including reserve tanks of the T-34, was 810 liters. From the interrogation, the consumption of fuel on the march appears to be about 2 gallons per mile.

9. Maintenance and Supply:

a. Prior to the hostilities, a weekly inspection was

customary in the North Korean Army. However, with the outbreak of the war, this practice was discontinued and the responsibility for the maintenance of the tank was left largely to the crew, with the occasional help of the technical company in the regiment. It would appear that the tanks were actually run until some part failed, at which time either the crew effected the necessary repair or obtained help.

b. In the 105th Armored Division each regiment had one special radio-equipped repair truck, equipped with machine tools and spare parts, but all these trucks and spare parts were lost by the time the division reached Seoul. From there on, they used ordinary trucks if available. In addition to the regimental technical company, the division had a technical battalion which the prisoners estimate had about 300 technicians. When a tank became disabled or immobilized and could not be repaired by the crew or the maintenance personnel in the regiment, it was usually left in place with its crew, because of the lack of recovery vehicles, and the division repair organization effected repairs in place.

c. There was general agreement among all prisoners that the spare-part supply was either non-existent or very small, and extensive cannibalization was required to keep the tanks in operation. This spare-parts shortage apparently existed before the Korean War started, according to one prisoner's statements, and tanks were cannibalized even during training maneuvers.

d. Originally the tank units had supply trucks for bringing up ammunition, fuel, rations and spare parts. However, most of these vehicles were soon lost to air attacks and they had to rely on captured equipment and supplies, augmented by native carts and porters. It would appear that during the advance in July and August, the logistic problem of the North Korean Army was eased to some degree by captured stocks of fuel and rations. Nevertheless, the majority of the prisoners complained that they were frequently immobilized through lack of supplies. Rations were often obtained locally, by commandeering through Peoples' Committees. What transport was available was restricted to night movement. The general impression obtained from the prisoners was that the supply situation was always very serious.

10. Reaction to UN Weapons:

a. Table II lists the prisoners experience with various UN weapons. Opinion of a prisoner as to which weapons he feared most was obtained when the prisoner's experience covered more than one type. The opinions on the most feared weapon can be summarized as shown in Table III.

b. It will be noted that only one of the 24 prisoners was without any experience from some form of attack. It should

REACTION TO UN WEAPONS

TABLE II

EXPERIENCE WITH UN WEAPONS

Interview Number	Air attack	Aritillery	Small arms	Other inf Weapons	Tank fire	Mines	No experience	Most feared Weapon
1	X	X	-	-	-	-	-	Strafing
2	X	-	-	-	-	-	-	Rockets
3	X	-	-	-	-	-	-	No opinion
4	X	-	-	-	-	-	-	Air Attack
5	X	-	-	X	-	X	-	Bazooka
6	X	-	-	-	-	-	-	Air attack
7	X	X	-	-	-	X	-	Rockets
8	X	-	-	-	-	-	-	No opinion
9	X	-	-	-	-	-	-	Air attack
10	X	X	-	X	X	-	-	Air attack
11	X	X	-	-	X	-	-	Naval gunfire
12	X	X	-	-	X	X	-	Napalm
13	X	-	-	-	-	-	-	Strafing
14	X	X	X	-	-	-	-	Strafing
15	-	X	-	-	-	-	-	No opinion
16	X	X	X	X	X	-	-	Napalm
17	X	-	-	-	-	-	-	No opinion
18	X	-	-	-	-	-	-	Napalm
19	-	-	-	-	-	-	X	No opinion
20	X	-	-	-	-	-	-	No opinion
21	X	X	X	-	-	-	-	Napalm
22	-	-	-	-	-	-	X	No opinion
23	X	X	-	-	-	-	-	Air attack
24	X	X	X	-	-	-	-	Hand grenades
All	21	11	4	3	4	3	2	

TABLE III

Weapon	Numbers
Napalm	4
Rockets	2
Strafing	3
Unspec. Air Attack	5
Bazooka	1
Naval Fire	1
Grenade	1
No Opinion	7
Total	24

be remembered that many of the prisoners were normally in support units and hence would more likely experience more attacks from aircraft than from any other weapon. This may tend to give undue emphasis to air attack. However, it is plain that air attacks were almost a common experience (21 out of 24) and that these attacks were feared over all other weapons. It is interesting to note that in one case where air attack and naval gunfire was experienced by one man, naval gunfire was considered worse. The single instance where a bazooka is mentioned is the only case where this weapon appeared to have any significance among the prisoners interrogated.

QUESTIONNAIRE

12 December 1950

QUESTIONNAIRE FOR INTERROGATION OF NK TANK CREW PW's ON ARMOR OPERATIONS

1. What was the circumstances under which you became a prisoner of war?

   a. When? Date? Hour of Day?

   b. Where? (Geographic)

   c. What was the mission of your unit at that time?

2. Was your tank disabled?

3. If disabled, what was the cause?

(For guidance of interrogator)

   a. Bazooka?

   b. U. S. Tank gun? (Caliber)

   c. Air attack?

      (1) Strafing?

      (2) Rockets?

      (3) Napalm?

      (4) H.E. bomb?

   d. Artillery fire? (Caliber)

   e. Anti-tank mine?

   f. U.N. infantry action?

      (1) Grenades?

      (2) S.A. fire?

   g. Mechanical failure?

   h. Loss of traction?

      (1) Mud?

      (2) Sand?

      (3) Steep grades?

      (4) Deep and wide ditches?

      (5) Vegetation?

      (6) Soft road shoulders?

   i. Exhaustion of fuel?

   j. Abandonment due to obstacles?

k. Self-destruction? What means?

l. Loss of contact with friendly forces and voluntary abandonment?

4. What was the situation of your tank at the time? On road? Dug in? Stationary? Ambuscade? Why?

5. How many times was your tank hit before it became disabled?

a. Was it penetrated?

b. Did it catch fire?

c. Where did it get hit?

d. Did you destroy your tank after it was disabled? What means did you use?

6. Did the tank crew suffer any casualties when the tank was disabled?

a. How many killed? How many wounded? How many captured?

b. Were any incurred when dismounting from tank?

7. Were you ever a crew member of a previous tank or tanks lost in combat? (If so, repeat 1-6).

8. In combat, normally what was the range when your tank opened fire?

9. What kinds of ammunition did your tank use and against what kinds of targets? How much of each kind was carried in the tank?

10. For what purpose did you use the machine gun in your tank?

(Interrogator)

a. Target designation?

b. Close-in protection?

c. Attack on infantry and other thin-skinned targets?

11. Did infantry provide NK tanks with flank and rear protection when in combat?

12. Were tanks frequently used to transport infantry or did infantry have its own transport?

13. Before an attack how were the tanks moved to their positions without being observed by UN forces?

(Interrogator)

a. Night movement?

b. Secondary roads?

c. Cross country, etc?

14. How did a NK tank unit usually make its night bivouac? What security measures were taken?

15. Did you like the performance characteristics of the T-34 tank as a fighting vehicle?

16. If not, why not?

17. Did you experience trouble with radio communications between tanks? Between tanks and infantry? If so, what was it?

18. Did you have trouble with the communication system within the tank? If so, what was it?

19. What services did you receive to maintain your tank in good operating condition?

a. Periodic maintenance?

b. Maintenance by tank crew?

c. Maintenance by unit tank mechanics?

d. Maintenance by rear maintenance units?

20. Did you have an ample supply of spare parts?

21. How much fuel did the T-34 consume in combat? On the march?

22. Did certain mechanical features of the T-34 frequently fail or give trouble? If so, what were they?

23. How were fuel, ammunition, rations, spare parts and other equipment supplied to the NK tanks?

24. Was this supply always reliable?

25. What UN Weapons did you see or experience prior to your becoming a PW? (Stress effect of air attack)

a. What?

b. Where?

c. When?

d. Reaction to each?

26. What UN tank did you consider best and fear the most? (Ask if PW saw a lot of action).

27. What anti-tank weapon or attack procedure did you fear the most?

28. Did you have trouble with anti-tank mines?

Interview Number 1

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations research Office
APO 301

12 December 1950

SUBJECT: Interrogation Armor Project

Name: Kim Dae Hyan
Rank: 1st Lt
Number: 61427
Age: 30 years
Unit: Self-propelled Gun Battalion, 6th Inf Div
Military Occupation: Supply Officer

1. Voluntarily surrendered Sept 28 at MunKyong. Mission to return to Kwagju from Munsan, near Chinju, to get clothing supply from the headquarters at Chinju. On his way back to Munsan he encountered American troops so ran up to MunKyong but found US troops there, so he surrendered. His battalion had 16 S/P guns but did not know the mission of battalion other than that of field artillery.

2. 14 guns out of 16 were destroyed while he was with battalion.

3. 14 were destroyed by air attack but does not know exactly what weapon caused their destruction. He saw the guns after attack and they were completely burned, with perforations about 1/2 - 1" in diameter.

4. Most of the guns were hidden in the hills when they were attacked, but does not know how many attacks were made. His absence from the battalion was for a period of a week so that the 14 guns were lost in that time.

5. See 3.

6. Does not know how many casualties were incurred during air attacks but the battalion suffered about 50 KIA and 20 WIA in battalion of 150, between June 25 and Sept 25 approximately. Battalion went into combat for the first time near Chinju about middle of July when UN troops were retreating. Most of the casualties were incurred from air attacks, bombs, strafing.

7. Not applicable.

8. Does not know.

9. Three kinds of ammo carried: AP, HE and some kind of incendiary (questionable).

10. Thinks light M/G was used against enemy infantry.

11. Not applicable.

12. Not applicable.

13. Guns were moved by night along main roads; never operated guns cross-country off the roads.

14. They had no fear of enemy attacks with the exception of air, so, in making a night bivouac, they took security measures only against air attacks by hiding in hills, camouflaging the guns by natural foliage, etc.

15. Did not like the SP guns as it was necessary to effect repairs continuously from the time they crossed the border. They drove the guns over the road all the way down to the south.

16. Did not know but believes that most trouble was with engines.

17. Radio communication between guns etc., was not good. Battalion CO constantly complaining but prisoner did not know what in particular was wrong with radio.

18. Communication between the driver and gun commander via telephone was good.

19. The crew did routine maintenance. Other maintenance was carried out under the supervision of the battalion and company technical officers. Does not know how often inspections of equipment were made.

20. Spare parts were obtained from disabled pieces. He knew of no other source.

21. He thinks S/P gun could go about 2.5 miles on a 5-gallon can of gasoline, rough guess only.

22. He does not know but battalion CO complained about quality of 3rd and 4th echelon maintenance and hence believes that most of their mechanical troubles were due to this condition.

23. In each battalion, verious officers had certain supply duties such as ammo, rations, clothing, fuel, etc, and they

were supposed to get these supplies at division headquarters. However, on fuel, clothing and rations, they largely depended on enemy supplies left behind. Ammo was brought up by truck. He never saw any porters used.

24. Supply was poor because they were forced to move only at night and because roads were badly damaged by air raids.

25. Experienced artillery and air attack, but feared most strafing which took place almost every day for nearly a month.

26. He saw only destroyed UN tanks, one burned and two abandoned and later attacked by UN planes. They were big tanks and were located in the Chinju area.

27. See 25.

28. No experience with mines.

Prisoner had grammar school education but his statements are not too reliable as he appeared to have very little sense of responsibility. Main motive was to please. Worked as a waiter and errand boy for Japanese. In the Army since December 1947.

INTERROGATOR: H. W. MacDonald, ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 2

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

12 December 1950

SUBJECT: Interrogation Armor Project

Name: San Dyck He
Rank: M/Sgt
Number: 63NK-16710
Unit: 105th Tank Regt
Age: 18 years
Military Occupation: Chief gunner in tank company. (15 day school)

1. Does not remember exact date of capture. Thinks about 20 September near Kimchon. Told to proceed to Taejon but when he reached Okchon, all 4 tanks were bombed and destroyed - joined infantry and marched to Taejon, then headed for Chochiwon. UN troops were already there so he changed to Kunju, crossed the Kum river, changed into civilian clothes and came to Chonan and surrendered to UN there.

2. Bombed.

3. Rocket - air.

4. On road.

5. Abandoned tank when planes appeared, but did not know how many times hit. Direct hit on engines and tank caught fire and was completely destroyed.

6. No.

7. No.

8. Max 2 - 3 kilometers---max effect at 1.9 kilometers.

9. Rounds: Armor-piercing (for tanks) 5; HE (buildings, etc)

20; fragmentation (personnel) 30.

10. MG was fired at same time as gun to lower enemy morale although they were aware range was too great. Usually fired at infantry when attacked. No use as target designation.

11. No flanks covered by infantry.

12. 15 - 20 infantry carried at times on tank.

13. Night movement - reconn troops in tank battalion examined road and ground for mines, obstacles, etc. Main roads used. Went cross country occasionally, found no great difficulty with ditches, most difficulty with rice paddies.

14. Ideal location about 10-20 meters off road, taking advantage of hills, etc., or camouflaged positions by digging-in tank and using pine boughs. The automatic-rifle men in battalion would guard area about one kilometer from the battalion CP. Tanks were lined up in two lines with guns pointing in direction of enemy.

15. Thinks it is very good tank. Has seen a small tank (10 ton) called Samouth with a 75mm gun (self-propelled gun SP/76).

16. See 15.

17. Seldom used radio because of poor equipment and not many tanks operating together - however used radio tank-to-infantry. Signal pistol used in combat for signal to infantry.

18. Very satisfactory.

19. Tanks transported from Pyongyang to Suwon by train. After running 40-50 miles, the driver checks the mechanical condition of tank in presence of chief mechanic of company. Not much maintenance by crew. Chief mechanic did preventive maintenance and minor repairs. Quite a few mechanics in battalion who do heavy repair work.

20. Very poor and hard to get - left Pyongyang without spares

21. One 55-gal drum would permit tank to go 20-25 miles.

22. Track breakage and steering controls.

23. Used horse carts commandeered from farmers. Trucks brought supplies to dump in rear, then carts were employed. No porters used.

24. Very poor, due to transportation difficulty and night movements.

INTERVIEW NUMBER 3

25. Experienced only air attack - bombing and strafing (all four tanks in his group destroyed by rockets by four jet aircraft). Previous experience in Kumchon, bombing and strafing with crew hiding in mountains - no casualties among tank crews-infantry WIA, KIA.

26. Never saw UN tank close - except one big tank with short gun, damaged and turned over.

27. Rocket bombing - air - saw tanks destroyed by napalm.

28. Never heard of NK tank destroyed by UN mine. Was told UN mines not strong enough to damage anything except light tank.

Prisoner quite intelligent and cooperative.

INTERROGATOR: H. W. MacDonald, ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 3

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

12 December 1950

SUBJECT: Interrogation Armor Project

Name: Lee Kil Soo
Rank: 2nd Lt
Number: 73508
Age: 21 years
Unit: 3rd Brigade or 346th Unit consisting of 1 battalion tanks, 1 battalion infantry and 1 battalion automatic weapons.
Military Occupation: Platoon leader of two tanks.

1. Captured at home. His unit moved down to Uijongbu area on Sept 19 but he followed two days later. When he came down to Uijongbu, he could not find his unit and village was under artillery fire so he retreated to the north and was captured by Security Police on 19 Oct. His unit was in reserve around Pyongyang without tanks and were ordered as infantry to Uijongbu. No actual training with tanks and no combat experience.

2. thru 7. Not applicable.

8. Says maximum effective range 2 kilometers.

9. 3 kinds: AP5, HE 20; Frag. 30.

10. Told to use against infantry.

11. In training, he was told that infantry would be with tanks on flanks and rear - 1 tank to 1 platoon infantry (45 troops).

12. No.

13. Prisoner was trained that when danger of discovery was imminent, he should hide the tank until the danger was removed. He was instructed to use the shapes of buildings to conceal the tank when in a village and when in the open to use foliage.

14. Trained to select a site, post guards, and send out patrols.

15. He was told in class that T-34 was not a reliable tank in the hands of NK Army as it was subject to mechanical difficulties which were hard to detect.

16. Engine troubles.

17. Told radio sets were effective up to 10-12 kilometers in motion and 18-20 kilometers when tank is stationary. The U.36-volt tube was very delicate and should be expected to give trouble.

18. Claims tanks were supposed to use a telegraph buzz system, as the noise and vibration were too much for a voice system.

19. He was told that after driving 3 kilometers they were to stop for 30 minutes to check fuel, oil, engines and track. After 6-7 kilometers a one-hour check should be made. If there is any trouble, the crew repair it if they can, otherwise Technical Co Com gets help from battalion.

20. Spare parts were to be carried in the tank and if they did not have the proper part then they were to radio to rear for special truck, especially equipped to repair tanks.

21. Full tanks 580 liters sufficient to last 250 hours (questionable).

22. See 16.

23. Supposed to be supplied by trucks.

24. Not applicable.

25. Experienced an aircraft attack on a village by F-51, firing rockets. House longside the one he was in was destroyed and his badly damaged. One rocket failed to explode, which they buried.

26. Saw none.

27. Not applicable.

28. On a movement south over the 38th Parallel, one truck in convoy exploded a mine but he does not know whose mine it was. The mine was a small one as only the back wheels of the truck were damaged.

Prisoner not very intelligent. 3 years school. In Army since March 1949. Worked in a mine before then.

INTERROGATOR: H. W. MacDonald, ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

INTERVIEW NUMBER 4

Interview Number 4

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

12 December 1950

SUBJECT: Interrogation Armor Project

Name: Wun Hong Ki
Rank: 2nd Lt
Number: 63NK-2453
Age: 23 years
Unit: 17th Tank Div
Military Occupation: Tank Platoon Commander

1. Surrounded near Taegu on 3 Sept with his crew. Their tanks shipped from Pyongyang to Pyongo in Chinchungpukto Province by rail - Pyongo to Taegu over road. Mission to support 8th Division in attack on Taegu. 17 tanks in unit, 4 crossed river and found themselves surrounded by ROK troops. 3 were destroyed when they refused to surrender. He surrendered his tank and crew.

2. Tank in good order.

3. See 2. (Other three tanks were destroyed by combination of air and ground fire; air rockets suspected).

4. On road.

5. Never under fire before.

6. No casualties.

7. No.

8. Effective range 3 kilometers - never fired in combat.

9. 5 AP; 20 HE; 30 Frag.

10. Both M/G used against infantry - turret M/G used to direct tank artillery fire.

11. In training yes - in combat after crossing river no infantry were available and they found themselves alone.

12. Would transport about 12 troops but prisoner had no personal experience.

13. Always moved at night but found that UN air would attack groves and orchards even though tanks could not be seen so, profiting from experience of others, they put tanks in buildings or destroyed villages where they could be easily camouflaged. Went cross country often because of destroyed bridges, roads. The maximum angle safe for tank sidewise was 35 degrees and 45 degrees lengthwise. Stayed out of rice paddies. Road shoulder traversable if not in excess of 25-30 degrees.

14. Afraid of air attack. Had no infantry with them so concealed tanks in buildings.

15. Reported that the T-34 they used saw service in 2nd World War but engines and guns and other parts were replaced and they were in good condition. Heard that T-34 was as good as UN heavy tank. Never saw a UN tank.

16. See 15.

17. No difficulty with radio communication between tanks. In training he was told to use flags when radio failed. No personal experience with signal pistol but understood that he was supposed to use it in communication with infantry.

18. Inter communication system not very good so used touch system.

19. Maintenance - crew is responsible for cleaning tank. Mechanical trouble - crew members worked under supervision of technical company commander (this is chief mechanic; a 1st Lt who is part of a tank company). Major repairs were carried out at battalion under supervision of battalion technical commander.

20. No spare parts.

21. Capacity fuel 810 liters but does not know how far tank would go on that amount. Technical company commander was responsible for refueling.

22. Steering handles and motor - heavy friction, and breaking of parts. In training many tanks damaged because of poor steering.

23. Coming from Pyongyang, they were told all supplies would be at front. When they reached front they found no supplies.

They were supposed to be brought by truck. Did not think gasoline or ammo were likely to be carried by cart.

24. See 23.

25. No previous experience except at time of surrender. All friends told him that he need fear nothing except air attacks. Artillery could not destroy tanks; had not heard of bazooka.

26. Had not heard of any UN tanks in his training.

27. Air attack.

28. No experience but saw NK engineers removing mines when he crossed Naktong river. Comrades reported UN mines ineffective as they only broke track occasionally, which could be repaired in 10-15 minutes. Self-propelled guns were usually upset, however, by mines.

Prisoner intelligent. Joined Army 1946, first in infantry. Sept 1949 transferred to tanks. Grammar school graduate.

INTERROGATOR: H. W. MacDonald, ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 5

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

13 December 1950

SUBJECT: Interrogation Armor Project

Name: Rim Nak Wen
Rank: Sen Capt
Number: 63NK-13017
Age: ?
Unit: 105th Armd Regt
Military Occupation: Supply Officer

1. Captured 21 Sept 1950 at Ansung, when ordered to move to Suwon. Unit mission to destroy UN troops coming down toward Suwon from Inchon - in Naktong district before move. When at Chonan UN troops unexpectedly moved into that town. At time of capture was transporting truck fuel for the tanks of the regiment.

2. 40 tanks destroyed or damaged in regiment. Some repaired and returned.

3. Major cause tanks destroyed: 10 by rocket bomb. Some destroyed by B-29 bombing because of imperfect camouflage. Some napalm, others tank fire. None from mechanical failure, none from terrain. 7 or 8 lost because of exhaustion of fuel - generally destroyed by unit.

4. Not known.

5. Estimates 6 or 7 tanks destroyed on first hit when engine caught fire. Other penetrations may not disable.

6. Crew - wounded but not KIA as a rule. Napalm gives them little time to abandon.

7. Question?

8. Not familiar.

9. Not familiar.

10. Not familiar.

11. In theory yes, but in actual combat tanks generally lead.

12. Only in special cases - river crossings or wide plains where RCT had no transport.

13. Up to firing line they move at night and stay until daybreak to attack. Use main roads as a rule.

14. Behind small wooded hills or in orchards. If enemy infantry attacked would send out defending infantry to hold the line until tanks can escape. If air-detected they moved to other position. They would send out a tank patrol (one tank) to each flank 1 to 2 kilometers, and one to front and rear with infantry. They were not able most times to establish a picket line.

15. Yes.

16. ---

17. Communications bad because of poor radio systems. UN listened in frequently so did not use radio much.

18. Not much difficulty.

19. After crossing 38th they stopped one week at Seoul for a complete check. When they arrived Naktong, checked again after driving from Seoul. Crew did maintenance on tank for minor repairs. If crew could not fix tank, it was generally evacuated to repair unit 5 or 6 kilometers in rear, (Maintenance Mechanics Company). No inspection by maintenance company, responsibility for condition of tank up to crew.

20. Very poor supply of parts which forced them to cannibalize good tanks.

21. 28 liters per hour on the march. In combat the same.

22. Not familiar.

23. When tanks are in combat, several reserve tanks are maintained fully equipped and fueled. These tanks relieve the tanks when ammo and fuel are exhausted. Company supply train of trucks brings up supplies to reserve tanks from supply point 7 to 8 kilometers in rear. Porters not used in his unit but heard of other units mobilizing villagers for transport.

24. Not very well, because they had to transport only at night due to air attacks.

25. Bombing and strafing at Naktong river early in September.

26. All he saw were armored cars and light tanks and hence did not fear them, as T-34 could cope with them.

27. Attack by bazooka.

28. Apparently encountered a lot of light mines which seldom damaged tanks.

Prisoner in army for 4 years. Age 25 years. Trained in North Korea. Grammar school graduate. Professional soldier. Apparently a reliable witness. No Russian advisors south of the 38th. Taught by Russians from 1948 to 1950. No other tank seen in training than T-34.

INTERROGATOR: H. W. MacDonald, ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 6

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

12 December 1950

SUBJECT: Interrogation Armor Project

Name: Kim Byung Joon
Rank: Sen Capt
Number: 63926
Age: 23 Years
Unit: Tank Regt (Ind) in Pyongyang under the Pyongyang area defense command.
Military Occupation: Reconnaissance Staff Officer mounted on a motorcycle.

1. Voluntarily surrendered on 17 October 1950 at Hukyo with three of his men. He had been told by his Regt CO to carry out a patrol at night and during the patrol he encountered US troops and surrendered. This patrol was on foot. Prisoner claims to be a non-communist and interpreted his orders for the patrol to be suicidal and hence he surrendered at first opportunity.

2. Regt had 20 tanks, 5 per company. Of this number 5 were destroyed on 17 October, all by air attack by bombing; probably 500-lb HE bombs. One tank caught fire.

3. See 2 above. Tanks were scattered 100-200 meters apart. Jet planes carried out the attack, 4 to a wave, with 3 reconnaissance planes with them. 8 separate attacks by 4 plane groups were made.

4. See 3 above. Located at the foot of a mountain about 100 meters off the road in a stationary firing position on a defense line.

5. Did not see damage personally but tank crews reported engines destroyed or damaged and tracks broken. One tank caught fire. Other tanks in regiment were in reserve and did not come under attack at that time. Tanks were abandoned in their

damaged condition at scene of attack.

6. No casualties, because crews abandoned tanks when aircraft appeared. Morale was low as the position was very advanced and men thought situation was hopeless.

7. No prior experience with tanks. Reconnaissance troops had no tanks.

8. Does not know.

9. Thinks two kinds of ammo used (not sure).
   a. AP 5
   b. HE 75-80 (?)

10. Never used M/G in tanks but believes they were used against enemy infantry.

11. In his training he was told that since tanks were faster than infantry, they will, depending on situation, go ahead of infantry to occupy certain objectives or stay behind and follow. (See 12)

12. They sometimes carried the automatic rifle squad (1 per tank) on the tank to protect the tank against enemy infantry. When enemy infantry were encountered, the squad was supposed to dismount and spread out. 10-13 men to a squad armed with tommy guns.

13. Night movement by main roads. Geography of Korea does not permit much use of secondary roads or cross-country manoeuvers.

14. They usually hid tanks in a village, camouflaged to resemble houses or haystacks, or up in the hills under the trees. The auto-rifle squad employed to guard the flanks, front and rear, with the heaviest concentration at the front.

15. He thinks T-34 a good tank. Never has seen any other tank.

16. See 15.

17. He reports radio between tanks, and between his motorcycle and tanks was good.

18. Telephone in tank was all right.

19. Company technical officer, in theory, was supposed to spend at least one hour checking tank after 3 - 4 hours operation. However, they usually kept the tank in operation until some part failed. Minor repairs are effected by crew if they can. If they cannot, the technical officer will help them. If it is beyond the capacity of company, help is obtained from battalion.

20. Spare parts very scarce. When tanks were brought from Russia, they came equipped with standard set of spares but these were quickly consumed or lost after arrival at Pyongyang.

21. Does not know.

22. Thinks T-34 good as a whole but electrical system gave most trouble.

23. Supply platoon in each battalion was responsible for ammo, rations, fuel, etc. Its trucks brought up supplies from Regt Hdqs, using commandeered carts when trucks were not available. No porters employed.

24. Supply very poor because of lack of supplies at original source, plus air attacks and transportation facilities.

25. Only weapon experienced was strafing in Pyongyang every day from August on. Not much damage or casualties.

26. Saw three just prior to surrender - medium tanks about same size as T-34 firing on his tanks and trenches. No hits observed.

27. Aircraft if tank is hit on the top. A hit beside the tank is not considered effective.

28. No experience.

Prisoner appears quite reliable with fairly high IQ. Grammar school graduate. In Army 4 years. Farmer before entering Army.

INTERROGATOR: H. W. MacDonald, ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 7

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

13 December 1950

SUBJECT: Interrogation Armor Project

Name: Kim Ji Soon
Rank: 2nd Lt
Number: 42548
Age: 21 years
Unit: 105th Tank Div 107th Regt
Military Occupation: Tank commander, later technical platoon leader. Joined army April 1947. With unit since Sept 1948. Was sergeant, commissioned April 1950.

1. Since 2 September, this division was at Kimchon; he was wounded in leg 22 Sept, was sent back to hospital at Yong Dong-Po. Surrendered to UN forces from Inchon at Siheung on 23 Sept before reaching hospital.

2. Yes.

3. 7 - 8 tanks of his unit were disabled through terrain difficulties. In Suwon, 3 tanks lost to mines, one to artillery around 3 July, the latter being penetrated and set on fire. In Taejon area, lost 5 - 6 tanks through air rockets and artillery. Does not know of any case of bazooka penetration. In Kum river area lost 9 tanks to air rockets and artillery, (prisoner personally counted them). From Taejon-Kimchon he reckons that the equivalent of two tank regiments was completely destroyed (some 130 tanks). Main cause of damage was air rockets, next flat trajectory weapons (tank guns). Prisoner stated that they never destroyed their own tanks, if out of order they left them with crew for technical battalion to come up and repair them. If seriously damaged, tank was cannibalized. A few were disabled by mines, but were repaired and put back in combat. Most of tanks were destroyed or damaged in action. When they stopped moving the camouflage was so good that they could not see them themselves a short distance away. On the Kum river, tanks crossed but infantry were prevented from doing so, hence tanks were left without support.

4. When wounded, he was not in a tank but was hit during an air strafing. Was with technical unit at the time.

5. When NK tanks were moving, UN tanks seldom hit them with first shot; generally required 3 or 4 shots to hit. When hit on gun mantlet, penetration was only occasional, but hull was easily penetrated. Always started fire when penetrated.

6. When tank was penetrated, all of crew killed. Most of those wounded were hit by air strafing after bailing out when air attack started. By the time they reached Kimchon they had about 60 percent casualties among original tank crews, but sufficient replacements had been received.

7. No.

8. Maximum effective range was 1300 meters when firing flat trajectory AP, maximum range 15,800 meters firing HE.

9. Should carry 55 rounds (AP 5; HE 20; anti-personnel 30). According to his experience they had to take what they could get.

10. Hull machine gun seldom used. Turret co-axial machine gun used against infantry.

11. In combat, if tank could break through defense without infantry clearing the way, they would go in with infantry on their decks. If not, they would give supporting fire to the infantry attack.

12. One tank can carry maximum of 20 infantrymen. They dismount when under fire. In infantry division there were a few trucks for ammunition and other supplies, but infantry always walk. Trucks, however, haul artillery and carry the gunners.

13. Always night movement. When tank unit moves, there is always one patrol tank 1 - 2 kilometers ahead of main body, usually carrying platoon or company commander. No cross-country movement, always on roads. When bridges were out, they could by-pass them across the rice paddies, even when flooded, in low gear.

14. At night, tanks were dispersed. Two tanks were posted up the road as a picket. Flank and rear protection were not practised. In regiment there is a mechanized infantry battalion, which is not used however for local security. At night, noise of tank engines carries 3 kilometers.

15. T-34 had transmission failures. Engine was not dustproof, and got clogged up. Trouble with road-wheel bearings frequent.

16. He considers T-34 inferior to most UN tanks.

17. Communications between tanks were effective. The original wireless operators were good, but replacements were not so well trained. In combat conditions radio communications with infantry were not good, and liaison was effected by messengers on motor-cycles.

18. Tank inter-phone system worked well.

19. (a) Thorough overhaul twice a year; summer and winter overhaul. On the march, after driving one hour they stop and check track, road-wheel bearings. After 2 - 3 hours they stop and allow engine to cool. Oil is changed in summer and winter.

(b) Crew did little maintenance at the front. Under peace-time conditions they had a weekly inspection. They checked the tank over every Saturday, it was inspected on Sunday. If minor repairs were necessary, crew did it, but engine repairs and major repairs were made by regimental technical company. The division had a heavy maintenance battalion for bigger jobs. Each regiment had one special repair truck with lathes, etc, but all were lost before reaching Seoul, and they had to use ordinary trucks. In a division they had 300 skilled technicians who came up and repaired damaged or broken-down tanks on the spot. There were no recovery vehicles available. In cold weather they put hot water in the radiators, and it took 25-30 minutes to get the tanks started. No attempt was made to run them daily if they were not in use during cold periods.

20. Practically no spare parts were received, and thus cannibal-ization was resorted to to keep tanks going. Before the Korean war started, this shortage existed, and 2 tanks disabled in manoeuvers were used for providing spare parts for the rest.

21. 25 gallons will last from Seoul-Taejon.

22. Teeth on main gear-shift broke frequently.

23. Regimental supply trucks follow tanks at a distance of about 8 kilometers, bringing up ammunition, fuel, rations. In a regiment there are supposed to be 43 trucks for this purpose, but they never had the full number available. When they got to Seoul on June 28th, they had only 4 left, having been air-attacked at Uijongbu. They had carried their supplies to Uijongbu which was a staging point on the way to Seoul, but they were attacked here and lost most of them. After this they used captured trucks, carts and porters. Supply was very poor, as they had to rely on night movement, and owing to the difficulty of handling supplies their movement was restricted, sometimes to only 10 miles a day. They were unable to go into action on the Naktong river for 20 days, because they were unable to move

them from there on account of UN air attack. When they used a cart, its capacity was 6 boxes (24 rounds) of 85mm ammunition. A porter could carry 2 rounds in his A-frame, or one round on his shoulder. Porters would carry ammunition from storage points to road, where it was generally ferried by ox-carts or captured trucks. Prisoner said that most of their transportation, which was in very short supply, was captured UN equipment.

24. ---

25. Prisoner experienced air attack and artillery fire. Was rocketed, bombed and strafed, but only saw napalm from a distance.

26. M-26 and M-46.

27. Air and artillery combined were feared by prisoner, especially air rockets. When air attacked, commanders sometimes told crews to leave tanks.

28. Between Seoul and Suwon, he personally saw two tanks that caught fire from mine explosions. No other cases were observed by him.

Intelligent. Did two years junior high school. Was clerk in an iron-factory before joining army. Has uncle in Tong-nae. Very co-operative and considered reliable.

INTERROGATOR: H. W. MacDonald, ORO, EUSAK, Capt E. D. Strong, ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 8

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

13 December 1950

SUBJECT: Interrogation Armor Project

Name: Lee Joeng Jin
Rank: 1st Lt
Number: 49345
Age: 26 years
Unit: 105th Armd Div, 107th Regt.
Military Occupation: Electrical Technical Officer. With unit since December 1948.

1. Surrendered Oct 5 at Umsong. He was in the rear of his unit at Chochiwon and his unit retreated so fast that he was left behind. At first, he decided to escape to the mountains along east coast, but when he went to Umsan he was told UN troops were all around and so he decided to surrender.

2. Never a member of a tank crew in combat.

3-14. Not applicable.

15. Very good but never had seen any other type.

16. See 15.

17. Radio communications between tanks was poor. Between tanks and infantry no communications except at regimental level. Reception was unsatisfactory. Prisoner considers that 9LS set used was poor.

18. This worked well, was clear.

19. Pre-war NK's had a weekly check. In combat area this was seldom done. In T-34's two systems of starting, one with air compressor, other with battery. Depended mainly on battery starter, but since these got run down they often had to start tank by pulling. Tank electrical system causes trouble owing to inferior material used, and poor relays. Frequent short-

circuiting, as they polished tanks with oil which got into wiring and caused "shorts". Electric traverse fails to operate properly when battery is weak, and is only used in emergency. The batteries they used were aged, having been brought from Russia, and the density of sulphuric acid used was not suitable for this type of climate. The battery cases were made of wood, and tended to leak. Battery charging equipment was not supplied by Russia, and Korean equipment used was not suitable. Sulphuric acid supply became difficult after Hungnam fertilizer factory was taken. Battery plates were easily broken. Crew members had scant electrical knowledge; even Russian advisers on electricity did not seem to know answers to his questions. Each regiment had one Russian adviser, but the 208th Training Regiment had 8.

20. Few spare parts. But received more electrical parts after war started than in pre-war days. After spell of combat they went to assembly points to re-equip, but outside these areas they could not get any spare parts. Chief shortage was batteries. Out of 10 tanks, only 2 might have good batteries. Prisoner was the only electrical technical officer in regiment and remained at assembly point.

21-22. Not applicable.

23. Used to carry bags of rice in tank. Fuel and ammo were supposed to come up by truck, but supply was unsatisfactory.

24. ---

25. Experienced only air attack, not at close quarters.

26-28. ---

Educated at technical college at Hungnam. Worked in power station before joining army. Was in army 2 years. Not very intelligent.

INTERROGATOR: H. W. MacDonald, ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

APPENDIX D

Interview Number 9

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

13 December 1950

SUBJECT: Interrogation Armor Project

Name: Eum Byung Keuk
Rank: 1st Lt
Number: 42528
Age: 22 years
Unit: 16th Tank Brigade (Ind)
Military Occupation: Signal Staff Officer

1. About 13 October, surrendered to Korean police at Chonan; it was raining hard and prisoner was tired and hungry, so he decided to leave his unit and surrender. His unit was retreating from vicinity of Taejon toward the northwest after being isolated in the mountains on Sept 28. Originally brigade had 22 tanks but by 28 Sept seven or eight remained. After establishing a defensive position and ordering men to defend to the end, battalion commander deserted whereupon the men left their tanks and retreated. Entered SK about 15 Aug - proceeded to Taejon but went no further south.

2. Prisoner reports that 5 of the brigade tanks were destroyed by air attack - automatic cannon (probably rocket and incendiary bomb - napalm). Of the remaining 10, some were abandoned for lack of parts (not sure as to fate of all tanks as operations of other battalions in brigade not known to him). He was in a tank which was attacked by aircraft with bombs and strafing but the attack was unsuccessful as bombs missed by about 15 m. to rear and the strafing did not hit tank.

3. See 2.

4. At time of air attack which prisoner experienced his battalion was on the march about 11 PM at night moving forward.

5. See 2.

6. No casualties in air attack mentioned. He was not sure of the number of casualties suffered among the crews of the 5 tanks

lost to air attack but he thinks that the number could not have been more than 2.

7. Not applicable.

8. Thinks maximum range 13 kilometers, but most effective range 7-8 kilometers.

9. AP-5, HE-20, Frag 30.

10. MG in forward slope was to defend against enemy infantry. Turret MG was used together with main gun against personnel driven from position by fire of gun.

11. No. Tanks operated at times far ahead of the infantry--no automatic rifle squads with this brigade.

12. Depending upon the tactics employed, the two infantry battalions which, with the 2 tank battalions, made up the brigade, rode on the tanks or operated separately using their trucks for transport as needed.

13. Always night movement to avoid air attack, on main roads only.

14. Security measures rather slack. Crew hid tank on hillside under trees or in a hollow place and covered with natural foliage; one or two members of crew stayed awake during night to guard tank. A better security arrangement was made when the unit expected to stay in one place for longer than one night.

15. Does not know as T-34 is only tank with which he is familiar. He says tank is an essential weapon for the infantry. In training he was told that T-34 was vulnerable to AP shot and some of his comrades told him that from their combat experience this was true.

16. See 15.

17. Reports that radio system was quite effective within range of 10 kilometers. Very little mechanical difficulty even though set was subjected to heavy vibration. The main difficulty was the lack of knowledge in the use of the set by the tank crews. As battalion signal officer, he was kept busy going around among the crews teaching them. Two models of sets were used in T-34, 9LS and 12LDM. The 9LS was the more common and best, the 12LDM was originally for self-propelled guns.

18. Radio telephone within tank was very effective but crews use of the communications system was very poor when in combat.

19. As far as he knows, his battalion was very careful in

maintaining the tanks in operating condition. The gunner is responsible for the gun and the driver for the engine, tracks, etc, the tank commander for the signal equipment. Very few tank commanders were qualified to repair the signal apparatus however. No regular inspection was made of the signal equipment after crossing the 38th Parallel; however he did check whenever he had the time. Repairs were performed by signal technicians in the signal company of the brigade.

20. Spare parts supply insufficient. Cannibalized a little; signal supplies were in greater quantity than other types.

21. About 20 liters per hour on the march.

22. Electric wiring and oil lubricating system failed at times.

23. Supply was by truck although tank carried about enough food and ammunition to last 2 weeks. No porters or carts used.

24. Supply system rather poor because of limited supplies, lack of transportation and air attack.

25. Air attack which he experienced - did not see other forms of combat.

26. Saw only destroyed UN tanks of a type smaller than T-34.

27. See 25.

28. No mines.

In the army since 1946, before that he was a farmer. Grammar school graduate. Prisoner not particularly responsive; probably intelligent but appeared bored.

INTERROGATOR: H. W. MacDonald, ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

INTERVIEW NUMBER 10

Interview Number 10

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

13 December 1950

SUBJECT: Interrogation Armor Project

Name: Kim Ki Chun
Rank: 1st Lt
Number: 73523
Age: 21 years
Unit: 46th Tank Regt (Ind) 10 tanks.
Military Occupation: Battalion Adjutant General. With unit 23 days; 23 Sept - Oct 14. (Prior to Sept with 19th Inf Div).

1. Surrendered 14 Oct at Koksan when unit was retreating from Imjin river. Prisoner was wounded by mortar fire. Prior to capture, he was leading three tanks to Korangpo to defend that town with an infantry battalion that was supposed to be there. Enroute, one tank was strafed and disabled and other two proceed to destination. Finding no infantry at Korangpo he retreated and was wounded in general vicinity of Korungpo losing a second tank in the retirement.

2. Two tanks disabled and lost.

3. One tank was hit on fuel tank, and caught fire, from air strafing from fighter plane. 2nd tank was fired on by artillery which pierced the armor on the front slope at an estimated range of 500 m. Prisoner had seen 4 UN tanks in vicinity at time of loss of the 2nd tank. The 3rd tank he is unable to account for.

4. Both tanks on road in daylight when lost. 2nd was attempting to turn when UN forces were sighted.

5. 2nd tank was penetrated on first shot but fire was maintained and several other penetrations were believed to have been made. It caught fire from these attacks.

6. Crew of first tank were unhurt. All members of crew of 2nd KIA inside.

7. No.

8. Does not know as he had never been in combat before in a tank.

9. His tanks had only anti-personnel ammo. (Frag) in his tanks (30 rounds). He was not able to obtain AP or HE.

10. To be used against enemy infantry.

11. In principle yes - in practice not at all times depending upon commanders plans.

12. Does not think tanks were used to transport infantry; previous experience in infantry did not indicate this method of transport. Infantry regiments had only 3-4 trucks and most trucks in NK army used to haul artillery.

13. Night movement by main roads. Rice paddies were avoided. No measure taken to conceal noise of tanks.

14. They would select a site near the highway at the foot of a hill, camouflage with the natural foliage available. He was told to camouflage in winter by covering with a sheet. Tank crew guarded tank. Regt rifle battalion was supposed to help in guarding the bivouac but seldom did so as the Regt was usually separated from the tanks.

15. Does not know much about tanks but was told T-34 was a good tank.

16. See 15.

17. Radio sets in his three tanks did not work and crew were unfamiliar in their use. Communication between tanks was verbal.

18. Were supposed to use the intercommunication system in tanks, but did not need it.

19. Did not perform any maintenance. The technicians in the company and battalion were untrained.

20. No spare parts.

21. Does not know.

22. Does not know but believes tracks gave considerable trouble.

23. Rear echelon was supposed to follow tanks with fuel, rations, ammo, but in his brief experience no ammo or rations were received and only a small amount of fuel. Rations were

frequently carried by cart but fuel and ammo were carried by truck. No porters were used.

24. See 23.

25. Air attack - strafing. Tank fire or 105mm artillery at Korangpo. Believes air attack more effective and fearful.

26. Does not know.

27. See 25.

28. No experience.

One year college but does not appear to be particularly intelligent. Went into the Army in July 1950.

INTERROGATOR: H. W. MacDonald, ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 11

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

13 December 1950

SUBJECT: Interrogation Armor Project

Name: Ja Man Kaun
Rank: 2nd Lt
Number: 43254
Age: 20 years
Unit: Ind Motorcycle Regt 603
Military Occupation: Chief mechanic and later platoon leader. With unit over one year.

1. Surrendered at Samcheonpo 29 Sept. Mission of regiment was to cooperate with infantry in capture of Samcheonpo and pursue the enemy. Some motorcycles were deadlined and it was his duty to send them back to rear for repair. However his unit retreated through him and he stayed behind and surrendered.

2-5. Not applicable.

6. Regiment almost completely annhilated at Shamcheonpo, Kosong, Okyupong.

7-16. Not applicable.

17. No radio.

18-19. Not applicable.

20. None.

21. Not applicable.

22. Motorcycles broke down often because of engine trouble.

23. No fuel supply from rear, depended on captured fuels and what they could promote from other units. Rations were obtained from the countryside.

24. See 23.

25. Received several air attacks, strafing by jet planes and naval gunfire (air burst and incendiary projectiles). Naval gunfire caused the greatest casualties and they feared it greatly. They failed to heed the presence of reconnaissance planes which directed the naval fire. Big ships were firing on them.

26. He saw 3 tanks which brought his unit under fire which caused a retreat to the hills with no casualties.

27. Not applicable.

28. No experience.

The function of the regiment was to maintain liaison between front and rear, to encircle enemy positions, to pursue retreating enemy, and to engage in street fightig.

Prisoner was junior high school graduate, cooperative but not particularly intelligent. In the army 3 years. Student prior to entering army.

INTERROGATOR: H. W. MacDonald, ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 12

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

14 December 1950

SUBJECT: Interrogation Armor Project

Name: Kwon Jae Youl
Rank: Sen Capt
Number: 14482
Age: 21 years
Unit: 203rd Regt, 105th Armd Div
Military Occupation: Technical Battalion Commander. No actual combat experience inside tanks. Joined army 1948.

1. Surrendered with 42 of his own men on Sept 23rd on the Naktong. Claims to have sabotaged six tanks by driving them into the Imjin river which he knew they could not cross, two at Suwon by destroying engine parts, three at Kimchon by destroying batteries, one at Naktong River by sending it into the river. Claims to have been jailed for three months after students revolt in NK, only way to get out and re-establish his reputation was by joining the army. Claims he ran away because he was afraid of court-martial for sabotage. Claims his father was killed by NK government because he was a landowner. Lt Col Oh of 105th Division will substantiate his claims.

2. Not applicable.

3. Regt started with 99 tanks. Prisoner claims that his division had, up to his capture, received approximately 200 replacement tanks. He believes that about 500 were allocated, but owing to air attack, abandonment on the way, shortage of experienced drivers to bring them down, only this number arrived. Many replacements had 150 hours driving when they arrived; the lifetime of a tank engine was considered to be 250 hours. He claims tanks were shipped to Hungnam from Russia, sent by rail to Chochiwon, and driven from there. Prisoner believes that the majority of the replacement tanks reached Chochiwon, but from here they were driven at night, and owing to poor roads and bad driving, many fell off into rice paddies, etc, and were

knocked out in the daytime by air attack. The prisoner states that of one shipment of 30 tanks he was personally bringing by road from Suwon to Taejon, he lost 25 on the way, of which 10 were salvaged about 10 days later. Most of these were mired by coming off road, and were later hit by air attack. He reckons that about 80 tanks were lost in this way between Suwon and Taejon. Sometimes the route used was a secondary road via Ansong which was more free from air attack, he reckons 10-15 tanks were lost on that route. Of the approximately 500 tanks which prisoner claims NK's lost, 300 were lost to air attack. He considered that more tanks were lost to land mines than to artillery, but they were repairable. Prisoner personally supervised repairs of about ten tanks damaged by land mines in his regiment. He considers that there were about 100 damaged by mines in the 105th Armored Division. The main cause of destruction of tanks by air was the napalm bomb, with about 70 rocket losses. Only a few tanks were abandoned for lack of fuel (estimated 15), but more were abandoned on account of weak batteries (estimated 30). There were no cases of self-destruction known to the prisoner.

4. Not applicable.

5. Tanks caught fire very easily on penetration or when hit by napalm. Prisoner knows of 4 tanks lost on entering Taejon, all penetrated by first shot and burnt. Says it was artillery, but prisoner never heard of bazooka.

6. When tanks fall off road, all of crew are generally casualties. Prisoner says driver and assistant driver are generally wounded, rest of crew killed. He attributes this to fact that the people in the turret get thrown about more.

7. Not applicable.

8. Maximum effective range about 1400 meters, but generally opened up about 800 meters. HVAP arrowhead ammunition is said to penetrate tanks at the higher figure of 1400 yards.

9. Carried 55 rounds, 5 AP, 30 Anti-personnel, 20 HE. Later they had an air burst anti-personnel shell, with a pre-set nose fuse. Few tanks knew how to use it.

10. Both machine guns used against infantry.

11. When they had a planned advance, tanks preceded SP guns by 200 meters, with infantry a further 200 meters behind. Infantry did not give flank protection.

12. Infantry were carried on tanks, on occasions up to 30.

13. Always night movement, along main roads. Tanks were unable

to deploy across the country.

14. From Taejon onwards always marched at night. Previously they occasionally stopped at night, and adopted all round protection with one man from each tank on guard. When they stopped by day they generally dispersed and hid themselves as best they could using natural cover.

15. When they were being instructed they were told that the T-34 was a superior tank to any American or British tank. He has no experience in action to refute or confirm this.

16. Not applicable.

17. Not good. Radio set all right but operation poor. First ones they had were good, but replacements were very poorly trained.

18. Works well. Used same radio set as for tank to tank communication, but could switch it on to the inter-phone system.

19. Driver responsible for the engine and tracks. If he was a poor mechanic, which was usual, the tank suffered. Replacement drivers poorer than the original ones. If driver couldn't fix repairs himself, he sent for regimental technical unit. Prisoner had 10 mechanics under him, he and one other were the only Russian-trained ones. He says there were only 25 Russian-trained mechanics, he knows of no others being taken prisoner, but 9 were killed to his knowledge. Each division has 3 special repair trucks, which were all gone by the time they reached the Imjin river. His own was lost crossing the river.

20. Had no spare parts. They had to cannibalize damaged tanks to keep the others running. They did not even have spare parts in Pyongyang before the war started.

21. 28 liters per hour.

22. Broken fans frequently gave trouble, they were unable to replace them. When tanks crossed river, fan sucked in water, causing engine failure. Clutch trouble frequently due to bad driving.

23. Tank (with reserve tanks) can carry 810 liters, but auxiliary tanks vulnerable to small arms fire, and often are not used, thus 620 liters were carried. Resupply of fuel and ammunition was obtained from disabled tanks, and several days supply of food was carried with them in the tank. Tank engines consumed 1.8 liters of oil per hour; oil was in very short supply. They could carry 40 liters with them, but were supposed to change oil every 20 hours. They were unable to do this owing to lack of oil.

24. As above.

25. Experienced air attack, tank attack, artillery attack and mines. Air attack sometimes 5-6 times a day. Tank attacks met with frequently, especially in Naktong area. Was most afraid of air attack, especially napalm.

26. Saw armored cars, M-24's, and bigger tanks with fire-power which penetrated his tanks.

27. As above, air attack, especially napalm.

28. See elsewhere.

Very intelligent. Graduate of technical college. Student before entering army. Very cooperative and considered reliable, though his figures are considered to be rather high for enemy tank losses.

INTERROGATORS: H. W. MacDonald, ORO, EUSAK, and Capt E. D. Strong, (UK), ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 13

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

14 December 1950

SUBJECT: Interrogation Armor Project

Name: Lee Keun Min
Rank: 2nd Lt
Number: 49456
Age: 23 years
Unit: 105th Armd Div, 107th Regt
Military Occupation: Technical Officer in charge of repairing batteries. With unit 2 years and 10 months.

1. Surrendered on 5 October at Umsang. His unit was retreating from the Chochiwon area and he went toward the east coast and, after separating himself from his unit, went into Umson. On the advice of a farmer he surrendered to the SK police. Saw little combat as his duty was in the rear.

2. Not applicable.

3. Not applicable. Prisoner not too sure of information but he believes regiment had 65 tanks originally and, at the time of the retreat from Chochiwon, approximately 30 remained. Some replacement tanks, approximately 30, were provided regiment from time of crossing border to his surrender. Reports from his comrades indicate air attack and artillery fire accounted for principal losses of tanks in his regiment. Saw many disabled tanks with damaged tracks and burned out engines. Few tanks had penetrations.

4-5. Not applicable.

6. Estimates 50 percent of regiment KIA.

7-13. Not applicable.

14. Does not know.

INTERVIEW NUMBER 13

15-16. Not applicable.

17. Heard that radio communications between tanks was not good because of lack of experience of the tank crews.

18. Not applicable.

19. No maintenance work done at front. The regimental technical company effected some repairs with occasional help from division. The principal trouble was engines.

20-21. Not applicable.

22. Most frequent trouble was with engines and fan which was frequently damaged by stones and other foreign matter entering engine compartment when engine covers were open in hot weather. Wheel bearings also burned out often. Does not think batteries were defective as the life of the battery was about one month and then they were removed for repairs. An ample supply of spare parts was available for this purpose. The sulphuric acid supply was limited, but no tank was ever deadlined through battery trouble as knocked out tanks provided enough batteries to keep others in operation. Battery cases leaked after about one month service. Some troubles with the batteries due to excessive use by crews in starting engines.

23-24. Not applicable.

25. Experienced only strafing and personally saw 3 KIA in his unit by strafing.

26. Saw one destroyed UN tank in Yongdong.

27. Not applicable.

28. Saw some tanks damaged by mines; the front parts of the tracks were usually broken.

Grammar school graduate; worked in Hungnam fertilizer factory as a battery man. He became a soldier in June 1950, previously working with the army as a civilian. Prisoner not very intelligent or reliable.

INTERROGATORS: H. W. MacDonald, ORO, EUSAK, and Capt E. D. Strong (UK) ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 14

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

14 December 1950

SUBJECT: Interrogation Armor Project

Name: Jun Sang Hyeon
Rank: 2nd Lt
Number: 14496
Age: 30 years
Unit: 2nd Division
Military Occupation: Division Technical Battalion Officer. In unit since June 1949 when he joined army.

1. Surrendered 30 Sept at Chongju. His unit was retreating from Chonju and he was isolated with three of his men on a hill, and surrendered. No actual combat experience with self-propelled guns, as he was repairing in the rear.

2. Not applicable.

3. 16 guns S/P in division - 11 were lost on way down from North Korea and five remained with division on the Naktong. The 11 lost and totally destroyed by fire enroute were lost thru air attack - rockets with M/G fire. Rockets penetrated armor. Fate unknown of five guns along Naktong.

4. The 11 guns were hidden and camouflaged, off the road as far as terrain would permit, and concealed with foliage.

5. See 3.

6. From 25 June - 30 Sept the technical battalion suffered 70 KIA, 19 WIA thru air attacks.

7. Not applicable.

8. Maximum range 5 miles, anti-tank or concrete pillbox effective range was 200 meters. Above this range they did not have a flat trajectory.

9. Only carried one kind of ammunition in his unit, 60 rounds anti-personnel.

10. No machine gun.

11. Not applicable.

12. Sometimes carried troops, maximum 30, up to line of attack.

13. Moved at night along main roads.

14. Moved off the road and placed 2 sentries with automatic weapons 50 meters to the front and rear. The battery supplied necessary sentries.

15. The Sam SP/76 is a good weapon in estimation of prisoner. Mobility and firepower good.

16. See 15.

17. Radio communication good.

18. Good - similiar to tank system.

19. Maintenance very poor - insufficient tools to accomplish maintenance and no spare parts. In addition air attacks, which were very frequent, prevented any maintenance that they could accomplish. This condition applied thru all echelons.

20. See 19.

21. The SP/76 consumed about 55 gallons for a 25-mile march.

22. The engine was improperly cooled, forcing the crew to halt the vehicle to cool the engine. 15 miles driving caused radiator to use all water.

23. Supply trucks followed artillery. In coming down from border, no difficulty in supply was experienced until the unit came under air attack and lost all its trucks. After trucks were lost had to depend on the few trucks remaining in division headquarters, which at times immobilized the unit for two to three days.

24. Fuel was very difficult to obtain at all times. The other items became difficult to obtain later because of air attacks and loss of transportation.

25. Air attack---continuous all along route advance artillery--Chongju middle August S. A. fire - Chongju Sept. Strafing was most effective and fearful. S. A. fire permitted some movement of troops but artillery and air attack forced them to remain

without movement.

26. Saw no tanks.

27. Not applicable.

28. No experience.

Grammar school graduate - skilled machinest. Fairly intelligent and cooperative.

INTERROGATORS: H. W. MacDonald, ORO, EUSAK & Capt E. D. Strong, (UK), ORO, EUSAK.
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 15

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

14 December 1950

SUBJECT: Interrogation Armor Report

Name: Kim Byeong Hak
Rank: 2d Lt
Number: 19525
Age: 22 years
Unit: 105th Armd Div, 107th Regt
Military Occupation: Began as supply sergeant; from April 27, 1950 was platoon leader.

1. Surrendered at Chungyu on 3 October. He was in hospital at Seoul for two weeks. When he joined unit at Chochiwon the NK forces were already retreating. He decided to leave unit, and surrendered to Korean police at Chungyu. He was wounded soon after crossing border.

2. His tank turned over owing to driver making mistakes, at Pochon. His tank was abandoned, having fallen upside down into ride paddy. This was on 25 June, first day of campaign. Doesn't know of any other tank losses at the time.

3-7. Not applicable; prisoner saw no action after this.

8. 1000 meters.

9. 55 rounds; 5 AP; 20 HE; 30 Anti-personnel.

10. Only against enemy infantry.

11. No. Tanks went ahead, infantry followed 500 meters behind, according to their teachings. But crossing the border infantry went over first, tanks went independently. There was no close cooperation.

12. Prisoner has carried 5-6 infantry on tank, most of whom were killed by enemy fire. Tank would occupy objective, infantry would be used to secure it. In 105th Division there was a

mechanized infantry regiment which had trucks to carry them, but other infantry had to walk.

13. No experience of trying this. Considers tanks were too noisy to keep their movement secret.

14. They were taught to provide themselves with all-round protection, to stay away from road, and that one crew member of each tank should stay on guard.

15. T-34 good fighting weapon, fast with good fire power, but maximum efficiency was not obtained owing to the unsuitable terrain conditions in Korea.

16. Radio communication was not very good. Reception was hampered by background noise. He himself was not well trained in radio, nor were his crew.

17. This worked well, no trouble.

18. Tank crew maintenance was not done in war. If anything went wrong, there was a long delay of, say, a fortnight, for spare parts to arrive even in peacetime. Tanks remained where they broke down, guarded by crew until unit mechanics came to them. They had a box of tools in tank for minor repairs.

19. Doesn't know much about it except as in question 18.

20. Consumed about 2 gallons per mile on the march.

21. Transmission failure when in low gear. For instance, pulling another tank or crossing rice paddy.

22. No experience of being supplied. When they crossed the border they carried several days supply with them.

23. Not applicable.

24. Saw very little action. Under artillery fire from one gun once.

25-27. Not applicable.

28. ---

Finished first year at high school. Joined army as infantryman in November 1948. Joined 105th Armd Div in May 1949. Prior to joining army laborer in a magnesite mine. Fairly intelligent, but of very limited experience. His crew fired only two rounds in training before going into action.

INTERROGATORS: H. W. MacDonald, ORO, EUSAK and Capt E. D. Strong (UK), ORO EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 16

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

15 December 1950

SUBJECT: Interrogation Armor Project

Name: Lee In Jin
Rank: 2nd Lt
Number: 201328
Age: 26 years
Unit: 105th Armd Div, 107th Regt. With unit since May 1949.
Military Occupation: First tank commander May 1949 - Aug 1950 and later platoon leader Aug 5 - Oct 2 1950.

1. Prisoner was having 2 tanks repaired at Sangju when UN forces occupied the town. He ran away to Hongchon. While resting in a house outside Hongchon, ROK troops appeared and arrested him on 2 Oct 1950. His unit was in retreat and scattered.

2. Yes, on two different occasions with different tanks.

3. His first disabled tank was on patrol with one other somewhere between Suwon and Osan. When the tank was passing over the top of a high pass with the other tank far behind, US artillery opened fire (105mm) WP hitting tank 3 times without penetration and without damage. The driver became excited, however, and lost control and the tank went off the road and fell into a rice paddy and became mired. Date 10 July 1950.

4. See 3.

5. See 3. The tank after becoming mired was abandoned by its crew who left the hatches open. The US artillery continued to fire and one round entered the tank through the drivers hatch, setting the tank on fire and destroying it.

6. The driver and assistant driver after abandoning the tank, sought shelter under the tank and were later killed by S/A fire. The rest of the crew escaped.

7. Yes. Between Chonan and Chochiwon at a town called Chon-Ni in an action to take Chon-Ni. Three patrol tanks were sent with prisoner's tank in the lead on the road. The three tanks passed the top of the rise safely but when two other tanks reached that point US troops opened fire with hand grenades, artillery and mortar. The first tank was hit by hand-grenade, fragments of which entered tank, presumably thru an open hatch, killing one member of the crew. The driver became excited and turned the tank at right angles to the line of march blocking the tanks following. Other crew members dismounted and were killed by hand grenades with the exception of the gunner who was wounded. Further grenades entered the tank and disabled it.

The 2nd tank tried to get by and fell into the ditch and the crew dismounted and escaped. Tank was brought under artillery fire and burned out. The 40 tanks that were following the advance party stopped and those that could opened fire on the US positions.

The prisoner's tank came under fire and was hit on the barrel about 50 cm from the turret by an artillery fragment. The prisoner was not aware of the damage to his gun, fired and broke off the barrel. He attempted to use M/G but, due to heavy enemy fire, crew abandoned tank with assistant driver wounded by a fragment which presumably came through the turret ring. Three were killed, the prisoner was wounded by artillery fire after dismounting. Because of continuous artillery fire on tank, the engine hatch or louvers were broken or loosened, permitting damage to engine and setting fire to tank.

The third tank was also hit by artillery fire (105mm) HE, with bazookas possibly, and destroyed by fire. The second tank had its front sprocket broken by artillery fire and the rubber on the bogie wheels set on fire. The crews of both tanks abandoned, and suffered 5 KIA and 5 WIA by hand grenades.

Date about middle of July.

8. 600-800 meters. Maximum range 18-20 kilometers.

9. Those T-34's with 5 speed shifts had extra space for ammunition storage in the back of the turret, permitting 94 rounds to be carried. 5 AP; 12 HE; 15 Incendiary; 62 anti-personnel, 7500 rounds M/G ammo and 30 grenades. (This is a bit questionable).

10. Anti-infantry.

11. Contrary to their training, it was their practice in combat for tanks to lead infantry sometimes by 12-24 hours.

12. Until they entered Seoul, a combat squad (11 men) was

carried on the tank. From Seoul on, this practice was stopped as the casualties among the passengers on the tanks were excessive.

13. In early phases of war, no attempt was made to conceal movement of tanks and they were deliberatley exposed to view to lower morale of the enemy. When the air attacks began, night movements were resorted to. Before they started night movement 8 tanks were lost in the division thru air attacks. Main roads used.

14. Depending on the terrain, they would bivouac tanks by companies, platoons or individually. When no infantry is available, crews guard tank with distance between tank and guard not greater than 30 meters. If infantry is present, the guard is maintained by the infantry. Patrol tank is posted 1000-1500 meters on the road to the front with infantry 400 meters to the flanks off the road. If no infantry available for flank guard, the tank crews must organize the guard.

15. Thinks it is a very good tank. He saw a Russian heavy tank which he believes had a 102mm gun (questionable). This tank was seen when Russians occupied North Korea and they had 20 of them.

16. Not applicable.

17. In training, radio communication between tanks was good, but in combat it was poor. Main difficulty was frequency adjustment and static interference.

18. Crews did not use intercom system, much preferring touch system.

19. After completing a mission, an inspection was made of the tank for defects, etc. Gunner examined his gun, driver his engine, radioman his radio, and a report was given to the commander who in turn reported to technical company commander. Unless the repair required part replacements, crew carried out necessary repairs. If repairs were of a more serious nature they were carried out by the technical company, in the regiment or divisional battalion.

20. Not enough spare parts. Most parts were obtained from damaged or destroyed tanks.

21. Fuel capacity 520 liters. They marched from Chorwan to Seoul on this amount.

22. Main mechanical failure was the fan which broke frequently. The second most frequent trouble was the excessive resistance offered in shifting gears. Forcing usually broke gears (this might be clutch trouble).

23. When coming into Seoul no difficulty was experienced, but south of Seoul transportation became very serious and porters and animal-drawn carts were mobilized to carry ammo, fuel (5-gallon cans), rations, etc.

24. No.

25. Artillery, air attack, S/A and hand grenades, tank fire. Air attack-napalm was the worst which he experienced. Artillery fire was not feared.

26. Only came across small tanks (probably M-24's) which were inferior to T-34's.

27. See 25 - napalm bombs.

28. No personal experience, though he saw several damaged tanks which he thought were mine-damaged.

Prisoner received 40 replacement tanks on 14 Sept at Kaesong. Doesn't know of unit replacements previously as he was in hospital. After this he was given light duty in rear. This unit had originally 40 tanks, organized in 3 battalions of 13 each, with 1 command tank.

Grammar school graduate. Joined army 1946. Prior to army life was a tailor. Intelligent and cooperative, fairly reliable.

INTERROGATORS: H. W. MacDonald, ORO, EUSAK, and Capt E. D. Strong (UK), ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 17

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

15 December 1950

SUBJECT: Interrogation Armor Project

Name: Lee Soo Sam
Rank: 1st Lt
Number: 34310
Age: 23 years
Unit: 105th Armd. Div., 107th Regt.
Military Occupation: Ration Supply Officer
Was with unit since 5 June 1950.

Previously was with 15th Tank Regt, the first tank unit in North Korea, since 1948. Was trained first as driver, later as commander, before entering supply.

1. Captured at Chinchon on 22 Oct. First wounded when retreating when his tank turned over, crossing a bridge over the Kum River. Sent to hospital at Taejon; when UN troops entered he left and was captured by ROK civilian guards.

2. Was in only one tank. When it fell off the bridge there were infantry riding on it, and 10 were killed and 16 wounded. It fell onto the ground beside the river and was pulled out by another tank. All the crew members were casualties except the driver, who commited suicide with automatic weapon becamse he was afraid of courts martial. This was only tank prisoner commanded. His division assembled at Cholwon, crossed border 25 June, came into Seoul by Hochon-Uijongbu road, then came down to Waegwan area along main route.

4-5. Not applicable.

6. See 2.

7. No.

8. Told in training that maximum effective range to open fire against tanks was 1600 meters.

9. 55 rounds: (5 AP; 20 HE; 30 anti-personnel), 2000 rounds machine gun ammunition, 25 hand grenades.

10. Against infantry.

11. Was told in training that they should do so, but in combat tanks led by themselves.

12. Carried troops, particularly when retreating, as infantry had no trucks of their own.

13. Night movement, or on rainy and foggy days.

14. In training learned three kinds of bivouacs: In rear assembly areas, no security measures taken. Within enemy artillery range, tanks are dispersed and hidden, guards posted. In forward areas, tanks are ready to move and crews remain on board. By day never remained on road, camouflaged tanks and hid them at foot of hills. In winter they were to use a white sheet.

15. Thinks it is very good, he has seen no other tank. Likes it because gun is accurate and has adequate hitting power. Has fired gun twice in training.

16. --

17. Was effective at beginning of campaign, but became less effective, he thinks on account of poorer operators that came as replacements.

18. Works better than between tanks. For simple orders, commander used foot - he gives signal to gunner who relays message to driver who sits below him.

19. He says that most of tanks damaged in action were repaired by regimental and divisional technical services.

20. Says that regiment and divisional technical companies have a supply of parts, but didn't know where they got them. Their efficiency was hampered by constant air raids which made them work at night.

21. Doesn't know. Says fuel capacity was 540 liters.

22. Doesn't know, but says mechanical failures were frequent, also terrain losses.

23. His regiment had only one truck left for fuel and one for ammunition when he left them. Most of the trucks were destroyed at Chonan. These two trucks were only moved at night. When tanks were not in combat they loaded on about 10 days supply of rice and hard bread. They could carry about 3 days rations

inside the tank, the rest was carried on the outside. Supplies were insufficient. He was supposed to get his rations from division. They were supplied by a military affairs committee which was a civilian organization responsible for commandeering food from the local countryside. They used carts and local inhabitants to convey this to their ration points, and to the various military units.

24. --

25. They experienced air attack, both strafing and rockets. No napalm.

26. Didn't see any.

27. Not applicable.

28. No experience.

Joined army June 1948. Is technical high school graduate, in engineering. Appears rather dull, considered valuable in the field of supply, but didn't know much about other questions.

INTERROGATORS: H. W. MacDonald, ORO, EUSAK
Capt. E. D. Strong (UK), ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

APPENDIX D

Interview Number 18

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

15 December 1950

SUBJECT: Interrogation Armor Project

Name: An Myong Sup
Rank: 2nd Lt
Number: 92481
Age: 24 years
Unit: 17th Ind Tank Brigade
Military Occupation: Technical Company Officer specializing in repair of guns. With unit since 25 Sept 50, prior to that with 208th Training Regt at Pyongyang. No combat experience.

1. Captured 30 Oct at Sunchon, N. Korea. His brigade was stationed at Chongju and then retreated to Siniuju but when they arrived at Sunchon they were subjected to a severe air attack which prevented them from moving (30 Oct). UN forces came in and captured prisoner.

2. No tank experience.

3. Prisoner reported unit was organized at Chongju about 25 Sept out of survivors of the 17th Tank Regt (Div?) which had been in S. Korea. The new brigade was equipped with 10 tanks which were all destroyed between Chongju and Sunchon by air attack rockets and napalm. Six-seven tanks were knocked out by napalm mostly at Kwaksan. Three at Sunchon.

4. He was not at scene but believed most tanks were attacked and destroyed around Kwaksan RR station while being unloaded and camouflaged. Three at Sunchon were in position off the road camouflaged on hills.

5. One direct hit was sufficient to set fire to tank.

6. Does not know.

7. Not applicable.

INTERVIEW NUMBER 18

8-9. Does not know.

10. Anti-infantry weapon.

11-12. Does not know.

13-14. Not applicable.

15. Never fired the guns in tanks in training, knows nothing about the performance of guns.

16-18. Not applicable.

19. Reported that he worked on traversing and elevating gear, when tanks were received, with the help of crew and Co. technicians of which there were seven. Co. technician group worked on traversing and elevating gear and recoil mechanisms, keeping oil correct. Sights, etc., were handled by the Defense Ministry factories (because of Ind. Brigade lacking Div maintenance units).

20. No parts on hand.

21. Not applicable.

22. Experienced trouble with excessive friction in the gears of the traversing and elevating mechanism. He worked on improving the operation of gears. They used power on the turret traverse very sparingly to conserve battery power.

23-24. Not applicable.

25. Air attack at Pyongyang when in training and at Chonju bombing (H.E.) and strafing buildings and bridges.

26-27. Not applicable.

28. None

4 years grammar school. Farmer before joining army. Cooperative but rather stupid.

INTERROGATORS: H. W. MacDonald, ORO, EUSAK
Capt. E. D. Strong (UK), ORO, EUSAK

TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 19

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

15 December 1950

SUBJECT: Interrogation Armor Project

Name: Kim Kie Yong
Rank: 2nd Lt
Number: 32689
Age: 25 years
Unit: 25th Inf Brigade, Tank Battalion
Brigade organized 25 August 1950.
Military Occupation: Assistant Company Commander

Graduated from military school just prior to joining unit. Unit was supposed to be equipped with tanks at Seoul on 22 Sept but UN troops had already landed at Inchon and he heard that the 11 tanks destined for the unit were destroyed by air attack either by rockets or napalm at Uijongbu while on the road to Seoul.

1. Surrendered 25 Sept at Seoul to Korean soldiers. Not in uniform after reading leaflet inviting surrender. Saw no combat other than the attack on Seoul.

2. Had no tanks.

3-5. See forward.

6-7. Not applicable.

8. Does not know.

9-12. Not applicable.

Experience of prisoner too limited to continue interrogation. He was not intelligent and had no first-hand knowledge whatever of tanks and tank warfare. Three years high school before entering military academy for one month training. Worked as a locomotive fireman after grammar school and returned to high school.
INTERROGATORS: H. W. MacDonald, ORO, EUSAK
Capt E. D. Strong (UK), ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 20

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

15 December 1950

SUBJECT: Interrogation Armor Project

Name: Lee Kuen Tak
Rank: 1st Lt
Number: 92505
Age: 27 years
Unit: 46th Ind Tank Regt
Military Occupation: Culture Officer. Was with this unit from its organization to his capture (2 months); previously with 3rd Inf Div.

1. Captured at Pyongyang on 29 Oct. Was retreating from Kumchon, his comrades who were from that province, deserted, but he arrived in Pyongyang alone wearing civilian clothes, where he was captured by Korean Security Police.

2. His unit had 10 tanks at the outset. It was organized at Kangtong, West of Pyongyang, in mid-Sept, and came as far south as Changton, just south of Kaesong. The forces retired without making contact with the enemy. They had two days combat at Kechong, near Kumchon, and by the time he surrendered they had lost all their tanks. Prisoner only knows that 2 were destroyed by air attack, doesn't know what happened to remainder.

3.-24. Prisoner does not know anything about tanks at all and was unable to answer any questions on tank warfare. His function was to give political training and lectures to NCO's, who were to pass it on to the troops. He was responsible for gathering information as to political trends of his own men, to correct undesirable tendencies, and report cases where correction was impossible to superior officers.

25. He experienced only one air attack, napalm being used against personnel when they were having lunch in a farmhouse. Two were killed, the others were able to disperse without injury.

Grammar school graduate. Communist party member. Intelligent. Satisfied with camp conditions, but would like more food

and some cigarettes.

INTERROGATORS: H. W. MacDonald, ORO, EUSAK
Capt. E. D. Strong (UK), ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 21

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

16 December 1950

SUBJECT: Interrogation Armor Project

Name: Jong Yo Won
Rank: 2nd Lt
Number: 201477
Age: 23 years
Unit: Tank Battalion, 27th Ind Brigade
Military Occupation: Supply Officer

1. Captured at Shibyon-ni on 13 Oct. His unit was as far south as Ilsan, on Han River north of Seoul, but when UN forces came up from Inchon it started to retreat, and came back to Kumchon by Munsan-Kaesong route. At Kumchon the troops were surrounded by UN and ROK forces, and attacked by air, so they separated. The prisoner went on to the hills, where he was captured by the ROK's.

2. His unit was newly organized, and had never received any tanks. Prisoner knew nothing about tanks; he was in an art school at Haeju prior to joining army in August. After 15 days training he was commissioned and put in charge of supply in this unit. The unit was still in process of being organized when sent to Ilsan.

3 to 8. Not applicable.

9. Never handled tank ammunition. Handled artillery and small arms ammunition. He received altogether about 10 trucks of 120mm artillery and 10 trucks of 45mm ammunition. The tank personnel had 8 trucks of their own for supply purposes; one was destroyed by air attack, but they received 3 new ones from Sinuiju and at the time of capture they had 10 in all. These were all Russian trucks (Geist).

10 to 22. Not applicable.

23. They had trucks as mentioned above. Under the brigade they

had an artillery supply section which was to look after 9 different battalions.

a. 4 heavy-machine gun battalions.
b. 1 tank battalion.
c. 1 120mm mortar battalion.
d. 1 76mm artillery battery.
e. 1 infantry battalion.
f. 1 engineer battalion.

They were to have one brigade transportation company but had only 8 trucks as already mentioned. The artillery supply section was responsible for the planning, and the transportation company hauled the supplies. This T/O&E was not filled before they moved, they actually had only:

a. 800 infantry.
b. 90 machine guns (heavy).
c. 40 machine guns (light).
d. 2 heavy mortars.
e. 11 76mm guns.
f. 8 trucks.

Originally the unit was to be fully mechanized, but this plan had to be changed. Prisoner said that the 8 trucks the unit had were not sufficient, and when retreating others were used in addition. Ration supply was inadequate; some was obtained from base units and some from local military affairs committees who obtained it from the local population.

25. Experienced air attack, artillery and S.A. fire; mostly air attack. He liked napalm bomb least of all.

26 to 28. No knowledge.

Two years art school. Had only a little training and does not know much, and his information is not considered very reliable. His training was mostly in engineering demolitions, was supposed to last 40 days, but took only 15 days. After being trained as engineer, he became a supply officer, as his unit had sufficient engineer officers when he joined them.

INTERROGATOR: Capt. E. D. Strong (UK), ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 22

HEADQUARTERS
EIGHTH UNITED STATES ARMY KOREA (EUSAK)
Operations Research Office
APO 301

16 December 1950

SUBJECT: Interrogation Armor Project

Name: Lim Kyong Soo
Rank: 1st Lt
Number: 49282
Age: 24 years
Unit: 105th Armd. Div., Div. Tech. Bn., joined unit May 1949
Military Occupation: Technical Officer

1. Surrendered on 2 Oct to US forces near Chongju and stayed with this unit for 2 days after giving information. One night he discovered that the unit had pulled out leaving him behind. He surrendered again to Korean police. His unit buried all its tanks and trucks (about 20 trucks and 10 tanks) in a hillside near Chochiwon which he reported to US forces which first captured him. Those tanks and trucks were uncovered by ROK forces and the trucks removed. The tanks were left and their disposition is unknown. He thinks other NK units did the same thing in burying tanks for further use. Some units also buried only parts, abandoning the tanks.

2. Was not in a tank in combat. Division had following regiments: 107th, 109th, 208th, 1st and 2nd. 208th was training regiment, 1st and 2nd regiments were along the southern end of the Naktong front. 107th and 109th were in the north around Waegwan. His friends in 107th and 109th regiments (which were largest in division) had about 100 tanks each. He does not know about other regiments. He personally took over 50 replacement tanks at Chupongyong in early August. These are the only replacements that he kows of.

3. Covering only the 107th and 109th regiments. The prisoner personally handled 32 combat disabled tanks and was able to restore to service 15. Twelve were burned by napalm, 15 by mines (all repairable), 2 by artillery in the Naktong. Sixteen additional were slightly damaged (repairable) by strafing.

4-5. Not applicable.

6. The cultural officer told prisoner that from start of war to the retreat from the Naktong there were 800 KIA, 3500 WIA, 3000 missing in division.

7. Not applicable.

8. About 4 kilometers.

9. AP and incendiary 30 and 25.

10-11. Not applicable.

12. Yes--carried a combat team on tanks up to Suwon but they suffered such heavy casualties that the practice was stopped. Casualties were particularly heavy at Uijongbu and Yongdongpo.

13. Patrols were sent out on foot to reconnoiter the position for the tanks, and the tanks moved at night after the position had been declared secure.

14. A site is selected for camouflaging tanks and one guard is posted on each tank.

15. Compared to newer models of Russian tanks T-34 was obsolete but it performed well in Korean war. He was in Russia from 1945-1949 at Vladivostok, Harbsk, Petrovsk and then returned to Vladivostok being trained as a tractor and tank mechanic. He saw two new tanks, B-32 and B-64. The first, the B-32 is about the same size as the T-34 but faster and armed with an 85mm gun. B-64 was armed with 121mm gun. The armor on front of turret was 15 cm and turret sides 10 cm. Front slope of hull 7-8 cm, weight 64 tons, 900 HP, 60 km/hr speed.

16. Not applicable.

17. Radio sets did not work very well--too much noise and vibrations injured parts.

18. Communication within tank not good. Same as 17.

19. Maintenance fair--supply of parts good with exception of batteries which were immobilizing many tanks.

20. See 19; prisoner admitted they cannibalized many disabled tanks.

21. Not applicable.

22. Most common failure was the starting mechanism.

23. Supply was hampered by air attacks, and carts and porters were employed.

INTERVIEW NUMBER 22

24-28. Not applicable.

Grammar school graduate. He had been a casual laborer before being sent to Russia. Not reliable and despite his apparent background was not well informed on tanks.

INTERROGATOR: H. W. MacDonald, ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 23

HEADQUARTERS
EIGHTH UNITED STATES ARMY KOREA (EUSAK)
Operations Research Office
APO 301

16 December 1950

SUBJECT: Interrogation Armor Project

Name: Ha Jeong Dong
Rank: 1st Lt
Number: 24654
Age: 29 years
Unit: Anti-tank Gun Bn., 5th Div.
Military Occupation: Temporary Company Commander. With unit since 18 Sept; prior to that with infantry in training. Joined Army 24 July 1950. Unit had two 45mm anti-tank guns with one unserviceable. Little combat experience.

1. Surrendered 30 Sept at Hongchon with 12 wounded. When first sent down from Pyongyang, no transport was available so he marched the distance from Pyongyang to Chongha near Pohang in 20 days with 150 replacements. He read many leaflets on the way and was in a mood to surrender by the time he reached his destination when opportunity offered. From Pyongyang to Seoul, he lived on Russian hard bread. From Seoul to the front, Peoples Committee provided food.

2-5. Not applicable.

6. In this company alone 30 KIA out of 36 assigned. Company was used as a replacement company. Most casualties due to artillery fire.

7. Not applicable.

8. Does not know, as he had never fired the gun nor had he been trained in its use. The unit had 120 rounds but apparently fired only 2 rounds of AP at infantry, then abandoned the guns and retreated.

9. AP only.

10-16. Not applicable.

17. Anti-tank company had one radio set for communication with battalion headquarters. It worked satisfactorily.

18-19. Not applicable.

20. None.

21-22. Not applicable.

23. Unit had two trucks for towing guns and these trucks were used at night to go to battalion headquarters for supplies.

24. Supply not reliable. Supply point was 25 miles inland from Chungha which is on the coast. Naval vessels off short prevented movement of trucks by day and hampered night movement, as headlights could not be used over the difficult mountainous roads.

25. Air attack and naval gun fire while at Chungha. Air attack was most feared. Three air attacks were experienced on march down from Pyongyang. The first in NK was strafing. Further south, bombing (50 kg HE) and strafing attacks were made. All attacks made at daybreak. March was made only at night. Only 2 WIA in all 3 attacks. First attack was made by 1 jet in North Korea, 2nd attack by 4 planes (B-26's), 3rd attack by 3 jets.

26. Never saw a UN tank.

27-28. Not applicable.

Grammar school graduate. Worked as a miner for 5 years and 4 years as a stevedore. Prisoner was not reliable, and was ill-informed on military questions. He had no training on anti-tank guns. He received one month of training in infantry tactics only.

INTERROGATOR: H. W. MacDonald, ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

Interview Number 24

HEADQUARTERS
EIGHTH UNITED STATES ARMY, KOREA (EUSAK)
Operations Research Office
APO 301

16 December 1950

SUBJECT: Interrogation Armor Project

Name: Won Kuk Man
Rank: 1st Lt
Number: 201506
Age: 27 years
Unit: Tank Battalion, 27th Inf Brigade, 19th Div.
Military Occupation: Company Commander. Was with unit from 28 Aug until his capture on 18 Oct.

1. Captured at Kumchon on 13 Oct. Unit withdrew from Ilsan via Munsan-Kaesong. When troops got to Kumchon they were surrounded. About 30 were captured in Kumchon, including prisoner.

2. The unit had not received its tanks. He was, before joining this unit, an assistant driver in the 107th Regt of the 105th Armored Division. He was hospitalized after receiving burn on his head by touching electric wiring in the tank in Seoul. Had little combat experience, as his tank was in the middle of a column of about 20 coming down to Seoul. He fired several shots at ROK stragglers along the road. His tank was hit twice by what he thinks was artillery without any appreciable damage, but something (probably .50 calibre bullet) hit the gun barrel and slightly damaged it, causing a small indentation. Among the other 20 tanks, six or seven were disabled, but five were repaired. The others were burned. He saw them burning, but doesn't know cause. Two of the losses were in Seoul. Thinks that hand grenade attack was probable cause.

3. --

4. On the road.

5. Three times hit. See 2.

6. The driver of his tank had a slight fragment wound received when driving with the hatch open. This was when the barrel was hit.

INTERVIEW NUMBER 24

7. No.

8. Not sure, 1100 meters was maximum opening range.

9. 3 kinds of ammunition. Usually carries 55, could carry 4 more. Five AP, 20 H.E., and 30 anti-personnel was normal load.

10. Lower machine gun used against enemy infantry at close range. Turret machine gun used against personnel at ranges shorter than main armament.

11. Tanks led infantry; their aim was to occupy objectives as quickly as possible, if they could do it unaided, all the better.

12. Prisoner says his tanks did not transport infantry, after early stages when infantry on tanks had heavy casualties.

13. Never attempted to conceal their movement. Moved by day and rested at night. (This was in early phase of war.)

14. Used hillsides along the roads or occasionally avenues of trees. Infantry guarded tanks at night.

15. Thinks it is a good weapon, but is not sure as he has seen no other tank. Is impressed by the gun's performance.

16. --

17. In company commander's tank there was a signal officer who was well trained who was able to maintain communication with other companies, battalions, etcetera. In other tanks, operators were less experienced, and as the radio performance was not so good, radio was used sparingly.

18. He says that there was a lot of noise in the earphones, so they often used touch system and shouting. Commander-gunner-driver relay by means of foot signals.

19-20. --

21. Doesn't know. Says tank carries 810 litres including reserve tank.

22. Steering levers sometimes became hard to move. Broken tracks also common.

23. On way to Seoul tank was refueled by trucks once; didn't need any other supplies as they carried sufficient.

24. Had very limited experience, so cannot say.

25. Had very little experience except as mentioned in question 2.

The nearest air attack he experienced was about a kilometer away in the Kumchon area.

26. Didn't see any UN tanks.

27. He was afraid of being isolated and attacked by infantry with hand grenades, etcetera.

28. No experience of mines personally, but saw mine-damaged tanks with broken tracks, and blown-in escape hatches. Latter caused casualties among crews.

Grammar school graduate. Was a farmer before joining army in May 1949. Not very intelligent, but co-operative and sincere.

INTERROGATOR: Capt. E. D. Strong, (UK), ORO, EUSAK
TRANSLATOR: Kilchoon Kim, ORO, EUSAK

APPENDIX E

EIGHTH-ARMY TANK CASUALTIES

Introduction

During January 1951 visits were paid to tank battalions operating with I and IX Corps; the only unit not contacted was the 89th Battalion, which was then taking part in Task Force Wolfhound. Complete casualty figures were obtained from the units (see Table III of the main report) and causes of losses since the Chinese offensive were discussed in detail. The use of armor during the period July-October 1950 is covered in Appendices F and K; these deal with the retirement to the Pusan perimeter, the holding action there, and the subsequent breakout and advance. During this period UN forces were engaging North Korean troops, who were supported by tank and antitank guns and who used mines haphazardly but with good terrain appreciation.

Casualties Prior to CCF Attack

The tank casualties sustained by I and IX Corps up to 1 November 1950 were as shown in Table I.

TABLE I

I AND IX CORPS CASUALTIES
UP TO 1 NOVEMBER 1950

(Figures in parentheses indicate total losses)

Cause	Number	Percent
Mechanical failure	102 (6)	45.5 (8.8)
Tank fire	13 (9)	5.8 (13.2)
Infantry attack	3 (3)	1.3 (4.4)
Terrain	19 (16)	8.5 (23.5)
Mines	51 (13)	22.8 (19.2)
Antitank guns	11 (6)*	4.9 (8.8)
Mortars	4 (1)	1.8 (1.5)
Abandoned: tactical causes	7 (7)	3.1 (10.3)
Artillery	8 (5)	3.6 (7.4)
Accidents	6 (2)	2.7 (2.9)
TOTAL	224 (68)	100.0 100.0

* Including two bazooka penetrations.

Mechanical failure and mines caused the greatest proportion of casualties, but approximately 70 percent of these were recovered and repaired. The most frequent single cause of losses was terrain, followed by mines, tank fire, and mechanical trouble.

The CCF Attack

By the beginning of November practically all the enemy's armor and antitank guns had been destroyed, and during the month of October our tank losses had been relatively light. However, on 2 November the 8th Cavalry Regiment was surrounded at Unsan by Chinese troops, and 10 tanks were knocked out or abandoned during the succeeding action. From this date up to 21 January 1951 the I and IX Corps lost 125 tanks as shown in Table II.

TABLE II

I AND IX CORPS CASUALTIES
BETWEEN 1 NOVEMBER 1950 AND 21 JANUARY 1951

(Figures in parentheses indicate total losses)

Cause	Number	Percent	
Mechanical failure	145 (74)	72.9	(59.2)
Tank fire	0	0.0	(0.0)
Infantry attack	16 (16)	8.0	(12.8)
Terrain	12 (12)	6.0	(9.6)
Mines	3 (3)	1.5	(2.4)
Antitank guns	8 (6)*	4.0	(4.8)
Mortars	1 (0)	0.5	(0.0)
Abandoned: tactical causes	10 (10)	5.0	(8.0)
Artillery	0	0.0	(0.0)
Accidents	4 (4)	2.0	(3.2)
TOTAL	199 (125)	100.0	100.0

* Includes six bazooka penetrations.

Table II shows a very high rate of mechanical failure, and a low recovery rate of disabled tanks (37 percent). The 125 total losses in this period constituted 62.8 percent of the casualties. The three mine casualties which occurred had to be abandoned owing to the enemy occupying the area before recovery could be affected. This small number of mine casualties can be accounted for by the fact that our forces were in withdrawal during most of the period. Casualties from tank and artillery fire are notably absent, and most of the few penetrations of armor were made by bazookas, which are believed to have been captured from UN forces.

Mechanical Casualties

MECHANICAL CASUALTIES

The causes of mechanical failure among tanks in Korea is analyzed in Appendix J; this shows the percentage of tanks with mechanical failure to be: M4A3, 20 percent; M24, 34 percent; M26, 40 percent; and M46, 40 percent.

The percentage of the total casualties caused by mechanical trouble has been about 60 percent. This can be attributed to several causes:

1. Many of the tanks sent to Korea were well-worn, having seen extensive service elsewhere.

2. The very rough terrain, combined with the high mileage covered by many units, put a great strain on all mechanical vehicles.

3. There was a shortage of skilled tank mechanics at all levels.

4. Supporting ordnance units at divisional level and higher were unable to give adequate support to the tank battalions. This resulted from the distances separating combat and support units, a factor that was aggravated by the poor roads, and the lack of spare parts in the hands of field maintenance units. The heavy requirements of the army in respect to rations, POL, and ammunition, coupled with the length of supply lines, resulted in the exclusion of Class II and IV supplies over considerable periods and prevented a stock of spare parts being built up.

Prior to 1 November only six out of 102 mechanical casualties were lost, but after this date 74 out of 145 were not recovered. This was because of the changed circumstances brought about by the UN withdrawal. Nearly all the tanks that were lost could have been recovered and repaired during an advance or in a static combat situation. From the time of the Chinese offensive of 26 November, UN tanks had to make long marches during the withdrawal from North Korea, and approximately 50 tanks which had broken down on the road had to be abandoned because there was neither the time nor equipment to repair them. Other tanks that were in the hands of ordnance had to be destroyed because they could not move, and 14 tanks were abandoned on flat cars at Pyongyang because there was no locomotive on hand to move them. Owing to the congestion, it was generally necessary to push disabled vehicles off the roads, and the steep road shoulders often caused tanks to overturn or to come to rest in places where salvage would be difficult even with heavy recovery equipment. The MSR Pyongyang-Kaesong-Seoul was used by most of the wheeled transport and by three of the four tank battalions originally in the Anju-Kunu-ri area; the other battalion undertook two long road marches, one from Kandong to Singye, over mountainous terrain, the other from Singye to Seoul. The evacuation from Seoul was accomplished over two MSR's via Suwon and Ichon, the 89th Tank Battalion going to Chonan, the 72nd to Hamchang, and the 6th and 70th to the Sanju

area. The total road distance covered during the withdrawal period (28 November-10 January) was between 400 and 500 miles.

Battle Casualties

Battle losses of tanks, most of which occurred in close-quarter fighting, were few, only about 20 percent of the total. On 24 November, when the Eighth Army began a limited offensive, the tank battalions were employed in support of their respective divisions, but once the withdrawal began they were only in sporadic contact with the enemy during delaying actions.

An exception to this was the 72nd Tank Battalion, which together with regimental tank companies of the 2nd Division, was employed in escorting the 2nd Division's column through the 9,000-yard CCF fire gauntlet on the road between Kunu-ri and Sunchon. The tanks were interspersed singly throughout the length of the column, in many cases with infantry riding on them. This was necessitated by the shortage of transport, and it led to infantrymen being left behind after they had to dismount when the tank came under fire. When engaged by CCF fire, which was almost exclusively from machine guns and small arms, the armor stopped to return the fire. This blocked the movement of the thin-skinned vehicles, and in consequence more casualties were sustained than would have been the case had these vehicles been able to keep moving. There were only a few places where tanks could have moved off the road to engage the enemy, and these were not where the enemy was most active. Although the tanks undoubtedly silenced enemy fire on a number of occasions, action of tanks, infantry, and artillery was not coordinated and there appeared to be a lack of control over the movement of the column as a whole.

Sixteen tanks were reported lost to infantry attack, but 12 of these tanks, British Cromwells, were lost in a single action near Uijongbu. These tanks, supporting elements of the 29th Brigade, were lost when withdrawing at night along a narrow track between high ground. The lead tank became disabled and blocked the road. The column was then attacked and overcome by CCF infantry; and only one tank crew escaped.

Enemy infantry did a lot of minor damage to tanks by knocking out periscopes, antenna bases, and other external fixtures by small-arms fire. Particularly at night, the enemy would attempt to overrun tanks and knock them out by placing satchel and pole charges and grenades in the tracks and engine compartments. Where tanks had adequate infantry support or were able to cover each other by fire, these attacks were abortive; but because of their limited vision, tanks were very vulnerable at night. The need for adequate artificial illumination of the battlefield or some form of night vision device was keenly felt by tank crews, especially when fighting an enemy who preferred

to fight at night. Bazookas and antitank rifles were used on a few occasions, six out of the eight armor penetrations coming from 3.5-inch bazookas.

Accuracy of Casualty Figures

Armor Officer, Eighth Army has reported that since the date of this casualty report (21 January 1951) ordnance units following advancing UN troops have recovered between 20 and 30 tanks formerly carried as abandoned. Nearly all of these tanks were destroyed or immobilized by our own troops or the enemy, but it is possible that some can be salvaged and reissued. If the UN advance continues, some revision will therefore have to be made in the number of tanks carried as total losses.

APPENDIX F

A REPORT ON ARMOR*

OBJECT

This report gives a short account of the use of armor, both friendly and enemy, in Korea, during the months July through October 1950.

DISCUSSION

Terrain

Armored operations in Korea were greatly hampered by the terrain. Korea is predominantly a rough, mountainous country. The highest peaks, nearly 9,000 feet high, are in the northeastern part of the country, but a nearly continuous mountain barrier extends southwards from the mass of mountains in the north. These mountains closely border the full length of the east coast. Spur ranges extend across the country southwestward from this main east-coast range. Only a small part of Korea is lowland, and most of the lowlands are small in area, lying in the main near the west coast between the spur ranges. They are intensively cultivated, with rice as the principal crop. The paddies, flooded for rice growing from June to October, generally proved impassable to armor during these months. The irrigation system--consisting of of dykes, canals, and ditches--is a further hindrance to movement even when the paddies are dry. The hill and mountain slopes are generally steep and eroded, and either bare or covered with secondary growth, except in the extreme north of Korea where there are extensive forests on the mountain slopes. In such country tanks were generally confined to the roads, or to adjacent dry river beds. Since mid-October, tanks have been able to deploy more easily in the valleys along the west coast because the rice paddies were dry and corn fields, which are passable, were more frequently encountered in the area north of Pyongyang.

Apart from a few areas in the immediate vicinity of principal towns, the roads are narrow and unpaved. Generally they are built up from 2 to 20 feet above the adjacent ground. The road

* Originally published as ORS/KOREA REPT. No. 1, 2 December 1950 by Captain Dennis Strong.

base is usually crushed stone, which has held up the roads quite well under heavy traffic, although the surfaces have become rough and dusty. The road shoulders have an average slope of 45 to 60 degrees from the horizontal. This prevents easy movement of wheeled vehicles off the road, although tanks have been able to by-pass blown bridges and other obstacles in most instances. Many road bridges will not take medium and heavy tanks.

Enemy Armor

On 25 June when NK forces crossed the 38th parallel, they had with them the 105th Armored Division, which spearheaded their advance down to the Pusan perimeter. This division had three tank regiments, each consisting of three battalions of 13 tanks and one command tank, a total of 120 tanks, all obsolescent T34's. The division split into its component regiments at Chochiwon, and each then operated indepently in the Chogye, Kumchon-Waegwan and Tabu-dong areas. The NK tank forces were reinforced by the 16th and 17th Armored Brigades, which were in reality armored regiments, having 43 and 40 tanks respectively. These brigades, constituted mainly from the 208th Training Regiment in Pyongyang, moved at night by rail and road to escape air attack. The 16th appeared in action on the Naktong front in the drive for Yongsan on about 1 September, and the 17th appeared in the Uihung area, northeast of Taegu, at about the same time. It is believed that owing to our air interdiction program, few tank replacements reached these units south of the 38th parallel. These tank units were almost completely wiped out, but the 105th Armored Division was reconstituted in Sinuiju and operated on the west coast.

During this period, 26 September to 21 October, seven field parties surveyed tanks left inoperative along major routes of movements south of Pyongyang. The 239 tank losses found were ascribed to the following causes:

TABLE I

NORTH KOREAN T34 TANK LOSSES

Cause	No.
Napalm	60
Air rockets	17
Bombs	7
Strafing	7
Air (not specified)	10
Tank fire	39
Artillery	5
Bazooka	13
Mines	1
T/6 aircraft	1
Abandoned	64
Unknown	15

The following points of interest emerge from this study:

1. Air accounted for 102 of the 175 tanks actually knocked out.

2. With a considerably smaller expenditure, napalm accounted for nearly four times the number of tanks as rockets. The normal load of close-support aircraft has been: F51 (Mustang), four to six 5-inch rockets, two 110-gallon napalm tanks, 2,000 rounds of cal .50 ammunition; and F80 (Shooting Star), four to eight rockets, 2,000 rounds of cal .50 ammunition. F80's are now being equipped with napalm containers. These containers, which are dropped using a low-level skip-bombing technique, have a forward splash of 150 to 200 feet, and on contact invariably set fire to the rubber on the tank's bogies, generating intense heat which "roasts" the crew and on occasions fires the fuel and detonates the ammunition. A direct hit on a tank with a napalm container invariably causes a complete blow-up.

3. It should be pointed out that owing to almost complete lack of opposition, aircraft were able to attack from a very low level without having to take evasive action. Also a higher proportion of aircraft per unit of front has been available than could be expected in any major war.

4. The large number of abandoned tanks appears to result from three main causes: mechanical failure aggravated by a shortage of spare parts, lack of fuel, and terrain difficulties. Further, a number were taken by surprise by the speed of the UN advance after the breakout from the Naktong River line.

5. The lack of an adequate US mine program in terrain well-suited to this weapon is apparent. This was partly caused by a shortage of personnel trained to lay mines, and partly by a lack of opportunity because of speed of the NK advance.

6. US 76-mm and 90-mm tank guns (APC muzzle velocity, 2,800 feet per second; HVAP, 3,400 feet per second) were able to penetrate the T34 at most angles up to 800 yards. The lack of opportunity to fire at greater ranges makes it difficult to obtain further information.

7. In addition, the surveys accounted for 74 NK 76-mm self-propelled guns as follows:

TABLE II

76-mm SP GUN CASUALTIES

Cause	No.
Napalm	13

TABLE II (continued)

Cause	No.
Air rocket	7
Bombs	5
Strafing	9
Air (not specified)	1
Tank fire	3
Artillery	11
Bazooka	4
Mines	1
Abandoned	16
Unknown	4

These guns were open at the top and rear, and their thin side armor was penetrable by cal .50 bullets.

Friendly Armor

Until early August the only friendly tank forces in Korea were four under-strength companies of M24 light tanks. Having neither armor protection nor a gun comparable to that of the T34, these suffered heavy losses. In the first week in August five tank battalions were landed. One contained 72 M46's (Pattons); the other four each had 69 tanks, M4A3's (Shermans) and M26's (Pershings) in approximately equal numbers. In addition, three organic tank companies, each consisting of 22 M4's were with the 2nd and 7th Divisions, and one was with the 5th RCT. The Marines also had a tank battalion consisting of four companies of M26's and three regimental antitank platoons. Thus the number of US tanks committed in Korea by the end of September was about 700, plus at least 7 M24's with each division for reconnaissance purposes.

Extracts from reports from US armored units, covering 137 tank casualties from July through October, show the following causes of casualties:

TABLE III

US ARMOR CASUALTIES (JULY-OCTOBER 1950)

Cause	No.*
Mines	44 (12)
Tank fire	12 (8)
Antitank guns	10 (4)
Artillery	4 (2)
Mortars	4 (1)
Terrain	16 (10)
Abandoned: tactical causes	5 (5)
Mechanical failure	39 (12)
Others	3 (1)

* Figures in parentheses indicate total losses; these number 55, or 40 percent of the casualties.

The information in Table III shows that 44 percent of the casualties resulted from causes other than weapons. Mud and steep treacherous slopes caused most of the terrain casualties, while much of the mechanical trouble could be attributed to the roughness of the country. The lack of sufficient power was a primary cause of mechanical trouble with the 47-ton M26 (500 hp); the 49-ton M46 with an 810 hp air-cooled engine performed extremely well considering that this was its first real test.

Although the NK forces used mines haphazardly and frequently failed to cover their mine fields with fire, their mines accounted for a high proportion of US tank casualties. Their wooden mines, the type most frequently encountered, contained 15.7 pounds of TNT or amatol, and normally blew one track and sprocket and broke the supporting brackets. In some instances they blew in, or at least buckled, the forward escape hatch. Our tank crews suffered few injuries from these mines. Other mines that have been uncovered consist of crudely fashioned box-mines, both wooden and metal, containing satchel charges. Some of these mines contain 50 pounds of explosives, and tanks that have hit them have been complete losses.

There were eight fires caused by penetration--six petrol fires and two ammunition fires. The small incidence of ammunition fires is attributed to low, confined storage of ammunition and to the projectile losing most of its energy in penetration.

Enemy Use of Tanks

The tactical use of tanks by NK force was changed completely during the campaing. In the early stages of the war, enemy armor boldly advanced down the main roads with no attempt at concealment. Small groups of tanks penetrated our positions to the front and flanks and thrust quickly to the rear, on occasions penetrating to command posts and artillery positions. Infantry attacks followed in 10 to 40 minutes, often accompanied by more tanks. Our antitank defenses, mainly the 2.36-inch rocket launchers and the 75-mm gun of the M24, were ineffective against the T34.

As our air and artillery attacks mounted in strength, the enemy confined movement of heavy equipment to nighttime and concealed his tanks in villages, railway tunnels, and the like, during the day. Tanks were moved up to attack positions at night, generally at slow speed and with the sound of their engines additionally camouflaged by long bursts of automatic weapons. Attacks were generally made at first light, closely followed by infantry. With our infantry in possession of the 3.5-inch rocket, enemy tanks were used more cautiously.

When the UN forces took the offensive, enemy tanks and AT guns were generally encountered in dug-in or camouflaged positions located either in defiles, with the intension of knocking out our

tanks from the flank or rear, or sited to fire on our tanks as they rounded curves on the road. In this respect, light aircraft flying at the head of our columns were of inestimable value, giving the lead tanks prior warning of enemy locations, road blocks, blown bridges, and other information. Also they were often able to detect freshly laid mine fields. The enemy 45- and 57-mm AT guns encountered were only able to penetrate our medium tanks at close range in the sides or rear, but the T34 85-mm arrowhead round was able to do so at least up to 800 yards. All armored units have commented on the inaccuracy of enemy tank and AT fire, which often has been off the target even at the short ranges used in Korea. Since the enemy sighting equipment is efficient, the fault must lie with the gunners, who may lack training.

Friendly Use of Tanks

US infantry divisions are authorized a divisional heavy tank battalion and a company of support tanks with each of the three regiments. As only one division arrived with its regimental companies, the available tank battalions were used to provide regimental tank companies for the other divisions. Thus most of the time the tanks were operating in close support of the infantry, under the infantry regimental commanders, although their logistical support was through their own battalion channels. As these infantry fantry-armor teams were committed to action without any opportunity to train together beforehand, maximum effectiveness was not obtained. Points that emerge from the infantry-armor study are:

1. The proportion of armor to infantry, one tank company per infantry regiment, has proved successful in overcoming NK resistance. In general, tanks moved along the valleys, giving fire support to infantry clearing the surrounding hills. With armor confined to a small number of roads, more tanks would have been a hindrance and their fire power would not have been utilzied.

2. Tank-infantry communications have not been satisfactory because of radio failures and because the infantry has insufficient equipment. Each tank has an ANVRC/3 set, a vehicular version of the infantry SCR-300, but theinfantry has only one SCR-300 per company. To assist tanks in overcoming their limited visibility, one SCR-300 per infantry platoon would improve the designation of tank targets. It is felt also that more use could have been made of alternative means of communication such as the tank's external telephone and pyrotechnics. Owing to the mountainous terrain, VHF communications between infantry regiments and division, and tank companies and battalion, have been intermittent, and messages have often had to be relayed through the light aircraft overhead.

3. When accompanied by armor, infantry have tended not to make full use of either their battalion heavy weapons company or the regimental mortar company. Although enemy personnel can be

engaged effectively with ricochet fire (HE fuzed delay) and cal .50 machine-gun fire from tanks, where possible maximum use should first be made of other supporting weapons because of the limited amount of ammunition the tank can carry.

4. The leading tanks generally carry infantry on their decks. Early faults in this practice, a result of lack of training, were overcrowding to the extent of preventing traverse of the gun, failure to dismount and disperse when under fire, and failure to mount quickly when the tanks desired to move.

5. Enemy mine fields caused considerable delay and casualties. The practice has been to accept the first loss in a mine field not precisely located, then sweep the remainder. The wooden mines used by the enemy were not easily detectable, and some mines had to be located by prodding. The presence of a mine detonating vehicle such as a flail tank would have been a great help. Mine fields, most frequently encountered in the vicinity of blown bridges, were seldom covered by fire in the period after the initial breakout from the Naktong line. On occasions when AT guns were present, they were sited close to the mine fields, and often knocked out before the tanks reached the mines. Recent reports state mine fields are being augmented by antitank ditches dug across the roads in defiles.

6. The ability of armor to exploit a breakthrough, even in the Korean terrain, was illustrated by the 172-mile drive of Task Force Lynch from Taegu to Suwon in 48 hours, to link up with the 7th Division moving inland from the Inchon beachhead. This was a remarkable achievement considering the terrain encountered. The enemy along the route was taken by surprise and put up little resistance. A further example was the drive of Task Force Dolvin from Chinju to Nonsan, a distance of 150 miles, between 25 and 30 September. These forces consisted of tanks and motorized infantry, with engineer and heavy mortar supporting units, and were accompanied by an air control party to call in tactical air support when needed. The limiting feature of these operations was the supply of petrol and ammunition, which had to be carried with the force. In such operations M26's have used 2 to 3 gallons per mile, and M46's, 4 to 5 gallons per mile; this was a fuel consumption considerably in excess of that anticipated.

7. The supply of tank companies has been affected through the battalion supply trains, who generally released half their vehicles to their companies and exchanged them when they came back empty. This system worked well, though there were local shortages of petrol and ammunition caused by the length of the supply lines, and there was an almost universal shortage of spare parts. This hampered the activities of battalion and company maintenance, who, apart from keeping tanks in running order, repaired most of the mine and AT fire damage, and in doing so had to resort to a good deal of cannibalization.

FRIENDLY USE OF TANKS

8. The M32 recovery vehicle, built on the M4 chassis, has been in great demand and has done excellent work, but it has insufficient power to recover M26's and M46's. A vehicle with a 30-ton hoist and 60-ton winch is needed for this job.

9. The 57- and 75-mm recoilless gun have not proved effective in engaging enemy armor. Hence, apart from the close-range bazookas, the tank has been the only effective ground antitank weapon. In this role, it has been kept with the forward infantry, by day and night, and widely dispersed. This has raised the morale of the infantry, but has proved unpopular with tank unit commanders because they like to keep their tanks together for purpose of control and mutual support and because tanks have proved vulnerable to close-quarter attack at night. Consideration is being given to the value of AT guns like the British 17-pounder to take over antitank defense when the infantry is in a static situation.

10. Because tank support was available, infantry have tended to keep close to the roads so as not to split the infantry-tank team. Thus the shorter and harder routes over the hills, which can be exploited for surprise effect, were seldom used. Infantry should not allow tanks to restrict their freedom of movement, and must be prepared to leave them behind when necessary.

CONCLUSIONS

1. This campaign has shown that armor can be effective in difficult terrain, even though handicapped by its inability to cross mud and high ground.

2. Although the peculiar circumstances which resulted in an appreciable number of aircraft being used on a narrow front without opposition may not be repeated elsewhere, the potential value of the tactical air force as a tank destroyer, using napalm, is self-evident. It is believed that further consideration should be given to the use in incendiaries in an antimateriel and antipersonnel role, both ground- and air-launched, and that consideration should also be given to the problems of defense against such attack.

3. The success of the comparatively crude NK mines shows that a quick means of detecting and/or removing metal and wooden mines is an urgent problem.

APPENDIX G

ARMOR AND INFANTRY

OPERATION PUNCH is one of the better examples of armor and infantry operating as a completely integrated team during Korean operations, and is therefore of interest chiefly as a study emphasizing equally the efficiency of combined tactics and the command system of which it came.

In early February 1951, I Corps and 25th Inf Div, then both headquartered at Suwon, were confronted by enemy forces of unknown size holding the higher ground between the forward elements of 25th and 3rd Inf Div and the line of the Han River, which averaged between 22 and 25 miles to the northward via the roadline.

25th Div, with 35th Inf Regt leading the attack, had but recently come to Suwon. Its elements, including the Turkish Brigade, then attached, had attacked on through to gain control of the lower ridges northward of the city. The enemy still held the dominant ground between Suwon and the Han--an east-west running hill mass about 10 miles north of the city. Hills 440 and 431 were parts of this massif which was characterized by sheer cliff facings and massive rock outcroppings along the summit. From these heights, one could look northward across the series of subordinate ridges flanking the Anchunchon River in its run almost due north to the Han.

Out of Suwon, there were two main roads leading northward. On the right was the MSR of I Corps, running via Anyangni to the Han River and thence to Seoul. This was hard-surfaced, asphalt for the greater part, and in reasonably good condition except for the frequent by-passes where bridges were out. The other road to the westward ran almost parallel to the MSR and was about 6,000 yards from it. It wound through the lower slopes of hill country, a fair dirt road in passable condition.

The general concept was that with the wresting of hill mass 440-431 from the enemy by direct infantry assault, there could be initiated "a strong armored attack into the enemy flank and rear to disrupt, disorganize and inflict maximum casualties upon him."

In brief, the capture of the massif would unhinge the enemy

in the middle ground between the two highways all the way to the Han. Before there could ensue a general withdrawal by CCF and NK, the infantry-armor columns would attack northward along the two highways, punishing the enemy along the flanking ridges, and doing the greatest possible hurt to his fractions. The immediate question was how best to employ the road columns so as to do maximum hurt to the enemy and provide maximum help to the infantry battalions which, remaining in contact with the enemy, still faced the task of destroying all that he held south of the Han.

In the novelty of the armored solution lies the item of paramount interest in the general operation. All of it was made feasible by the success of the attack on Hills 440 and 431, where 2nd Bn, 35th Inf, and Co L, 27th Inf Regt, engaged with unusual gallantry. This part of the general operation was committed to detailed study at the company level. It is of unusual importance as an infantry study, both because of the exceptional volume of fire developed by the supporting weapons and the resource and hardihood of the foot force. Elements of the Turkish Brigade also engaged in the assault against the massif. Although they are too frequently described in our press as engaging with greater dash and tenacity than American infantry, the details of this fight would not sustain any such comparison. A major part of the difficulty and ordeal of the American force came of morale weakness in the ally which was supposed to sustain its flank.

However, what happened in the Hill 440 attack is not considered germane to this study. Suffice to say that the massif was captured after four days of heavy action and so cleared the ground for OPERATION PUNCH, which was to carry I Corps from Suwon to the Han River.

Two armored task forces had been organized in anticipation of the situation. They were composed as follows:

TF Bartlett, including:

64th Tank Bn, less Co C
2nd Bn, 27th Inf, with mortar plat and one plat of quad .50's
Plat of Co A, 65th Eng Bn
Med and Sig Det, 25th Div
Organic TACP

TF Dolvin, including:

89th Tank Bn, less Co's A, C and D
Co C, 64th Tank Bn
1st Bn, 27th Inf, with mortar plat and one plat of quad .50's
Plat of Co A, 65th Eng Bn
Med and Sig Det, 25th Div
TACP of 27th Inf Regt

TF Bartlett moved via the left flank road leading from Suwon to Sosari, the juncture point on the Inchon-Yongdungpo highway. TF Dolvin moved via the MSR running from Suwon to Yongdungpo. Concurrently with this roughly pinching movement by the armor, the final assault was made by the troops in line to break the enemy hold on Hill Mass 431-440, thus shaking the enemy loose from the dominant middle ground while the armored sweep began its enveloping run along the two flanks. On 3 February, TF's Bartlett and Dolvin moved to assembly areas, both in the Suwon neighborhood. On 4 February, OPERATION PUNCH was held up temporarily while awaiting the development of a more favorable situation on the right flank, in 3rd Inf Div's sector. On 5 Feb, at 0745, TF Bartlett crossed its LD and attacked north. Its objective for the day was the ridge at 105-400, and by 1525, it had been won. TF Dolvin crossed the LD at 0700. By 1250, it had secured its objective for the day, the high ground along the MSR immediately east of Anyangni; also, it had cleared the eastern edge of the town itself.

Both TF's were then withdrawn. TF Bartlett came back to the MLR by mid-afternoon and was put into a blocking position within the MLR. TF Dolvin moved back prior to darkness to a blocking position within the MLR covering 25th Div's right flank.

Both TF's had engaged enemy throughout the day, and had won their local fights handily. Each had gained to forward ground and was well enroute to the Han. Even so, the area thus brought under control was relinquished. The friendly columns withdrew to base and the enemy fractions continued their hopeless attempt to rebuild along the flanks of the two highways.

This was to become the pattern of OPERATION PUNCH throughout the next several days, though in the first instance decision had not been taken that the armor would be employed in exactly this way. The tanks, and their infantry attachment, served by their manner of attack to entice the enemy into the trap rather than to snare small numbers by means of a rapid but incomplete envelopment. So doing, their success became almost unqualified.

On 6 February, TF Dolvin hit again at 0745 and had reached Hill 300 (177-420) by 1400; this was the objective for the day. By 1420 one of Dolvin's patrols had gotten to 150-430 and had become quite heavily engaged. TF Bartlett, attacking at 0720, had by 1205 hours established its two teams in the forward ground at 098-412 and 108-418. Both TF's had met relatively stiff resistance by CCF and NK. Persistent enemy mining of the two roads was proving a major annoyance. In some instances, the asphalt had been tunneled under to the center of the pavement. The trigger mechanism of the mine so placed obtruded not more than one-half inch above the surface. In great numbers, mines of two main types had been laid along the road shoulders; 81 mm mortar shells had been bound together in blocks of five and fitted with a

detonater; besides this improvisation, there were 26-pound blocks of explosive. The work for the most part had been done so hastily, however, that the greater number of mines were covered by only a thin sprinkling of dirt. Except for one day when a fall of snow covered this rather crude field work, no material damage was done to the columns. But every morning there were fresh mines to be cleared away from road stretches which had been free of them the day before. CCF showed a marked preference for the mining of the major defiles, and it was not uncommon to find 50 or 60 mines in one such small area.

Again on 6 February both TF's pulled back to within the MLR by 1600, completing the movement by nightfall. They resumed the attack on 7 February at 0700 hours. By 1430 TF Dolvin had secured Hill 178 in the vicinity of 145-425. Elements of the 35th Inf (2nd Bn) then relieved TF Dolvin in that position and consolidated the gains for the day, the TF returning to its assembly area. TF Bartlett's advance along the road to the westward brought it forward to approximately the same east-west line. By 1500 TF Bartlett had been relieved by the Turkish Armed Force Command, and the TF returned to an assembly area behind the MLR.

On 8 February, TF Dolvin, retracing its ground of the day before, had by mid-afternoon traveled an additional 2,000 yards to the vicinity of 148-434 against moderate-to-heavy resistance. At 1550 hours, it again started to withdraw, its "B" team having meanwhile advanced an additional 1,000 yards across country. That brought it to Hill 284 (161-449) where it became heavily engaged by CCF and stopped for the day. TF Bartlett, making a fresh advance of approximately 3,000 yards, halted to permit the Turkish force to come forward and consolidate the ground. TF Bartlett then withdrew to an assembly area behind the MLR, closing at 1700.

Crossing the LD at 0800 9 February TF Dolvin had advanced to vicinity of 154-511 by 1500 hours. This had been a fresh advance for the day of 1,700 yards and carried TF Dolvin to a point where its guns could fire into Yongdongpo. The TF then returned to the assembly area. TF Bartlett moved out at 0813, advancing against light resistance. By 1310 hours, its lead elements were at 106-488--a fresh advance for the day of 5,000 yards. It then again drew back.

The TF's were dissolved that night; in their place was TF Allen, operating directly under I Corps. Its mission was continuation of the general task of inflicting maximum hurt to the enemy south of the Han. It was to proceed from an LD along the Yongdungpo-Inchon highway, which LD had to be secured by 1200 of the following day, this latter task falling to the 24th and 35th Inf Regts and the Turkish Armed Force Command.

OPERATION PUNCH ceased with the dissolution of the two TF's.

The order which set it in motion had not specified the tactics and method of tank-infantry cooperation.

The decision as to whether the two armored columns would stay forward or would be withdrawn was made each day at about 1200 by the 25th Div commander. To this extent, the plan and the grand tactics which came of it were strictly empirical.

Command System

The following principles of cooperation in combined tactics were adopted within TF Dolvin and are in essence the fundamentals which brought about the unity of the infantry and armored elements in both TF's, with resultant harmony and efficiency in the operations:

1. Infantry and armored staffs were wedded.

2. Each tank company was teamed with an infantry company.

3. Infantry and tank platoon commanders rode together side by side on the same tank.

4. The halt, fire and deployment were done on the order of the infantry company commander; the order from higher authority did not read that way; the TF was set up as an armored force, reinforced by infantry; but the two battalion commanders agreed that this was the practical method.

5. The TAC and artillery FO's rode with Dolvin, the tank commander.

6. While the TF was mounted up, the tank communications system was used throughout.

7. Upon engagement opening, the fire of the quad .50's was controlled by Dolvin through normal tank channels.

Tactics

1. The armor did not fire while the infantry was mounted.

2. The two infantry platoons which were to be first in the assault were mounted up front; they were in effect tactically disposed while riding on the tanks.

3. When fire came against the column, it halted immediately and the infantry was deployed.

4. In the absence of fire, the armor rode the infantry as far as possible into the position to be taken under attack.

5. "As far as possible" was in this instance considered to mean within "effective small arms range" of such enemy as might be holding the position. At that point, the force was deployed irrespective of the fire situation.

6. The platoon of quad .50's was split into two sections of three tracks each; they were used with the two lead companies, leaving none for the reserve.

7. When any enemy force was located, it was engaged with all guns by the armor and by the quad .50's as soon as the infantry had dismounted and was ready.

8. Air strikes and field artillery fire were called for at every opportunity.

9. The combined metal barraged all ground which the infartry assault line was preparing to take under attack.

The Attack

What these methods yielded during operation is best exemplified by looking at one part of the operation as a whole. When TF Dolvin jumped-off, the 35th RCT was already in possession of Hill 427 which is just short of Anyangni and approximately 2,500 yards due south of it. The town had not been taken, but from the heights of 427 one could look into it. East of 427 and next to the village of Myonghaktong, along the MSR, there is a lower ridge, Hill 109. From this vantage point, the two commanders (Lt Col Welborn G. Dolvin and Lt Col Gilbert J. Check) and their staffs were afforded a fairly clear view of the opening problem.

Directly to the north of Anyangni, and on the other side of the MSR, was another imposing series of ridges which culminated in Hill 300. When taken, it would shake the enemy out of Anyangni and loosen his hold on the subordinate ridges flanking the MSR for several miles to the northward. The question was whether the armor could be split three ways to go against the hill mass from the south in such way as to put fire on the three main draws. It was intended that the column should advance up the MSR without firing, then peel off, with the infantry riding the tanks right to the base of the hill if possible. The foreground was a frozen river bed, interlaced with dikes and occasional paddies. Viewed from Hill 109 two days before the attack, it looked feasible. But the reconnaissance did not end there. The day before the attack, all infantry and tank company commanders were flown out of Suwon in L-5's. The planes got down to within 300-600 feet of the objective and the commanders determined by visual inspection within what limits they could operate.

In the attack on the first day, the plan agreed upon was followed in detail. At Myonghaktong the armor began its

deployment, 18 tanks moving directly north in column until they left the road, then advancing in platoon column as they crossed ice patches toward the hill. As they deployed, they opened fire.

The second company, which was to come in on the left, moved a little farther northward along the MSR, and deployed due north against the hill mass. Each tank opened fire with its cal .50 as the ground brought the object into clear view. They came into line gradually along the base of the hill, until all 30 were squared away; then all 30 opened fire with their artillery pieces (76's) against the heights. Preparatory fire by the artillery, which anticipated the infantry assault, lasted for 30 minutes.

The quad .50's positioned themselves about 100 yards behind the tanks and distributed themselves evenly along this line (there were four quads with each tank company). Fire areas along the hill had been assigned to each company and the supporting quads. These were further broken down into platoon fire areas.

The infantry companies had dismounted as the tanks peeled off in making the approach to the hill. Until then, there had been no fire from either side. But when the infantry got down, immediately small arms and automatic fire broke out from Hill 300. In squad column, the infantry companies advanced to the hill base, moving through the line of armor.

The infantry line waited there for 30 minutes while the hill was taken under fire by all available forces--armor, the quads, the field artillery, the 4.2 and 81 mm mortars, the latter fire from high ground to southward of the frozen river.

As the infantry line started its climb uphill, vehicular fire was shifted to the crest, and artillery was lifted to the ridges and escape routes beyond Hill 300. At that point fire control was passed into the hands of the infantry company commander who was moving up with his artillery FO, and the former henceforth directly controlled fires from armor and quads until the hill was taken

One man moving in lead of each infantry platoon was wearing a red panel on his back. This enabled the tanks to follow visually the advance of the infantry line. In support of the infantry components meeting any real strong point resistance, all general fire was shifted to the heart of it.

By 1300 hours, Hill 300 had been taken at no cost in life to the US. An enemy force estimated in excess of 200 had been killed or driven off. 27th Regt's 3rd Bn remained atop Hill 300 for several hours. From there they were in position to fire into Anyangni. The reserve tank and infantry company then moved into the town, meeting no resistance. The lead platoon of tanks went through with no infantry aboard. Passing unscathed, it was followed by the other platoons with infantry aboard. This was a protection less against small arms fire from the houses than against mining of roads.

ARMOR AND INFANTRY

Having won both the hill and the town, TF Dolvin returned them to the enemy in late afternoon. The hill was attacked again on the following day; again there was resistance, but it was lighter and the end result was the same. Having fled Anyangni, the enemy returned at night only to undertake road-mining operations and then get out again before first light.

Results of Operation

Though the total cost of OPERATION PUNCH, and the attack through the middle ground which made it possible, has not been computed in terms of dead, wounded and missing on both sides, the ratio of enemy loss to casualties in the attacking side is suggested by the round figures.

CCF had little heart for meeting the combined armor-infantry attack along its flanks. Its fire was erratic from the beginning. As day followed day, there was steadily less cohesion in the resistance.

The bitterest fighting had attended the capture of Hills 440 and 431. There the enemy had held stubbornly. The total of American infantry casualties, KIA and MIA, was less than 100 at that point, of which 21 were KIA. The two armored columns had operated with relative impunity for the greater part of a week. Dolvin's armored battalion had only three men WIA; Check's infantry battalion (1st Bn, 27th Inf) had trifling losses. On Bartlett's side of the roundup, the story was the same, though the accompanying infantry action witnessed the most effective bayonet charge by US infantry since the Civil War.

Yet when the countryside was clear of enemy as far northward as the south bank of the Han River, the bodies of 4,251 dead CCF and NK soldiers were counted on this ground. Of this number, approximately one-tenth had died defending Hills 440 and 431. The greater part of the slaughter had been accomplished by the armored sweeps of OPERATION PUNCH.

Comment

Lt Col Dolvin: "The complete success of the operation was due to the complete integration of the two staffs. We thought and acted not as tankers and as infantrymen, but as men confronted with a single problem . . . and I'll add that the quad .50's are an extremely effective weapon in this type of operation. They're a great discourager. In the attack against Hill 300, the quads alone fired 80,000 rounds. But as an accompanying weapon, rather than in an AA role, they need a new chassis; the quad should be mounted on a track."

Lt Col Check: "From the moment when we decided to merge staffs. the operation was made."

APPENDIX H

TANK BATTALION COMMUNICATIONS

Introduction

In November 1950 tank communications were discussed with officers of two of the Eighth Army tank battalions. As a result of these discussions, a questionnaire was prepared which, early in December, was presented to officers of the remaining three tank battalions. The discussions and questions naturally reflect experience to that date, and opinions may well have been changed since then.

The questionnaire and the answers (not verbatim) received from various officers are included as Annex 1. The conclusions, from the early discussions with the officers of the two battalions, are included in Annex 1 in the form of answers. Those interviewed were: three commanding officers, one executive officer, four communication officers, seven company commanders, and four platoon leaders.

Annex 2 gives an outline specification of the various radio sets mentioned in this appendix. The answers to the questionnaire are summarized and discussed below.

Discussion

1. Communications between tank battalion headquarters and higher echelons are satisfactory.

2. Communications between battalion headquarters and company headquarters are not satisfactory. The SCR 508/528, although not strictly a VHF set--20 to 28 Mc/s, whereas the VHF band starts at 30 Mc/s--will not give much more than "line of sight" communications, and will certainly not provide communications over distances of the order of 60 miles, which it has been expected to do.

3. A solution to this problem, already instituted in one battalion, is to use an HF radio. The consensus of opinion is that this equipment should be carried in the company commander's jeep in addition to the SCR 508, which most of them now have, and that CW communication is sufficient, provided trained operators

are available. The SCR 506 is a suitable set; it has a specified range of 75 miles on CW and 25 miles on voice when stationary, or 50 and 15 miles respectively when moving. Installing this equipment in a jeep, in addition to the SCR 508, will impose a very heavy drain on the batteries, and special charging facilities and careful maintenance will be required.

4. Communications from tank company to tank platoon and from tank to tank are satisfactory.

5. Breakdown of the main radio equipment has sometimes caused the intercommunications facilities to fail, and when this occurs a tank is practically helpless. In the past, British tanks have been fitted with emergency sound-powered intercommunication facilities. This installation consisted of a sound-powered microphone for the commander, connected into the normal headsets of the other crew members. The latter cannot talk to the commander, but signals can easily be arranged by which they can acknowledge orders. The alternative is to design the intercommunication system separately from the main radio. Although it would then be more reliable than at present, there would be no assurance that it would not break down.

6. The maximum numbers of channels used at various levels on a tank set are:

SCR 508:	Battalion headquarters	3
	Company commander	7
	Platoon leader	3
SCR 528:		2

However, most people would be content to have four channels. It would appear that the present radio sets have more channels than are necessary. A tank radio set is very rarely switched to a different channel during an engagement, thus a set with five channels should cover present needs, expecially if they could be set up quickly by the tank commander or wireless operator, so that if there were a last-minute change of tanks from one platoon or company to another the new frequency could be set in on the spot.

7. The AN/VRC 3 is technically a satisfactory radio for tank-infantry communications. A power unit is definitely needed and should be made sufficiently robust to withstand the gun blast. The AN/VRC 3 does not, however, provide the full facilities required in that it does not provide communications between the tank and infantry platoons. Possible solutions are to install a separate radio in the tank for this purpose; to design a radio for the tank that will provide the present facilities plus the extra required; or to redesign the infantry platoon set so that it has a frequency overlap with the company set.

8. The tank telephone is satisfactory, but better use could

have been made of it by the infantry. This is considered to be mainly a question of joint training. It has been suggested that the telephone should be mounted lower on the tank so that infantrymen can reach it without standing up.

9. A tank column needs direct communications with the T6 (Mosquito) aircraft for the control of close air-support strikes. It may be that this will be satisfactorily provided now that the T6's are equipped with an SCR 300 radio. The alternative is to equip a tank, for the use of a forward air controller, with the additional VHF radio required for ground-air communications. The 1st Marine Division organic aviation units do have such a tank, the "Porcupine", with a dummy gun, for the use of the forward air controllers.

10. The present system of switching to transmit is not satisfactory. The switches need to be arranged so that both can be operated with one hand, leaving the commander one hand with which to hold on.

11. The channel buttons of the SCR 508/528 are at present much too inaccessible.

Recommendations

12. To maintain battalion-company communications, additional SCR 506 radios should be provided together with adequate operating and maintenance personnel. These radios should be mounted in the auxiliary vehicles.

13. The tank intercommunication system should be made more reliable either by designing a unit separate from the main radio or by providing an emergency system.

14. For infantry-tank operations, communications from the tank to the infantry platoon should be provided by one of the methods specified in paragraph 7 preceding.

15. The tank telephone should be mounted lower on the tank so that infantrymen can reach it without standing up.

16. If the recent addition of a SCR 300 to the equipment of the T6 control aircraft does not provide satisfactory close air support communications, a tank, with dummy gun, should be fitted with a VHF radio for the control of close air support strikes.

17. The two switches required for radio transmission should be mounted, possibly on the microphone handle, so that both can be operated with one hand.

18. The channel selector push buttons on radio sets should be mounted so that they are easily accessible to the tank commander.

APPENDIX H, ANNEX 1

TANK COMMUNICATION QUESTIONNAIRE AND ANSWERS*

QUESTION 1: Have communications been satisfactory between your battalion and the next higher formation?

Comm O: Yes, they have been satisfactory with the SCR 506. This is normally mounted in a half-track, but the installation should be modified to permit the set to be taken out and operated from a tent in static locations so that the operators can have some heating.

Comm O: Yes, but there is a great shortage of skilled operators.

CO: Yes.

CO: Yes.

QUESTION 2: Have communications been satisfactory between battalion headquarters and companies?

Comm O: No, not with the SCR 508 even though RC 292 and 296 antennas have been used. Companies have been as much as 60 miles from battalion headquarters. The liaison plane has been used as a verbal relay station when it has been airborne, but a verbal relay is never really satisfactory.

Comm O: No, the SCR 508 does not have the range required for the present type of operations in Korean terrain.

Comm O: The SCR 508 is all right. The companies do lose contact with battalion headquarters, but they are controlled by the infantry at any rate.

CO: No, the SCR 508 is not good enough for battalion-company communications in the present type of operation. I normally fly in the liaison plane or else this acts as a relay station, but other communications are required.

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* Abbreviations used here are: Comm O, communication officers; CO, commanding officer; Co Comd, company commander; Plat Ldr, platoon leader; and Exec O, executive officer.

CO: No, we do use the liaison plane as a verbal relay but this is not completely satisfactory.

Co Comd: The companies have rarely been within range of battalion headquarters.

Co Comd: The SCR 508 is not satisfactory. I have an SCR 506 in my ¼-ton as well as the SCR 508.

Co Comd: We do lose touch with battalion headquarters, but we are controlled by the infantry anyway.

QUESTION 3: If the answer to the previous question is "No," would a high frequency set be suitable for this net, and if so should it be mounted in a tank or in the company commanders' auxiliary vehicles (¼-ton)? Further, is voice communication required or is CW sufficient?

CO: Yes, HF equipment is required, but the T/O&E must be amended to include operators and maintenance personnel. At the present time we have a SCR 506 mounted in the company commanders' jeeps in addition to the SCR 508. This causes a very heavy battery drain and good maintenance is essential. CW is sufficient if really good operators are available.

CO: Yes, an HF set is required. It should be carried in the auxiliary vehicles. CW is sufficient but voice communications are better.

Comm O: Yes, an HF set is required. The equipment should be carried in the auxiliary vehicles, but we must have maintenance and operational personnel for it.

Co Comd: Yes. We have SCR 506 radios in the company commanders' jeeps. CW is sufficient with good operator, but I prefer voice.

QUESTION 4: Have communications been satisfactory within the company? That is:

a) Company to platoon;
b) Tank to tank; and the
c) Tank intercommunications system.

Co Comd and 2 Comm O's: a) Yes, very good.
b) Yes, very good.
c) Yes.

Comm O and 2 Co Comds: a) Very good.
b) Very good.
c) See next question.

ANNEX 1

QUESTION 5: Has failure of the SCR 508/528 caused the intercommunication system to fail at any time?

2 Comm O's: There has been very little trouble. The radios do sometimes go but this rarely affects intercommunications.

Comm O: Yes, we have tried fitting a sound-powered system for intercommunication, but the mechanics with the battalion had neither the qualifications nor the materials to make a success of the installation.

Co Comd: Yes, on two occasions. Once when the radio set was hit and once as a result of fault in the set.

QUESTION 6: How many channels are needed on a tank radio set?

Comm O: The minimum is four:

1.	(a) Battalion command channel (b) Division command channel (c) Spare (d) Spare	SCR 508 Battalion hq
2.	(a) Battalion command channel (b) Company command channel (c) Spare (d) Spare	SCR 508 Co Comd
3.	(a) Company command channel (b) Platoon channel (c) Battalion command channel (d) Spare	SCR 508 Plat dr
4.	(a) Platoon channel (b) Battalion command channel (c) Spare (d) Spare	SCR 528 Tank

Each company and platoon will of course have different frequencies. One battalion headquarters spare is for air warning, maintenance, administration, and the like. The CO normally flies in the liaison plane, and it is SOP for all tanks to monitor the battalion command channel when the plane is in their vicinity.

Comm O: The minimum is five:
(a) Battalion command net
(b) Reconnaissance net
(c) A company
(d) B company
(e) C company

The liaison plane is retained by division headquarters, and the battalion commander likes to be able to listen in on each company net.

CO: I would be perfectly content with two reliable channels. (This CO flies in the liaison plane, and is presumably basing his judgment on the two channel SCR 510 in the aircraft.)

QUESTION 7: How many channels of (a) the SCR 508 and (b) the SCR 528 are normally used in one action:

Comm O: (a) Not more than three.
(b) One; each platoon has a different frequency set up on the same channel.

Comm O: (a) Three.
(b) Two (battalion and platoon).

Co Comd: (a) Company commanders use six (one per platoon (4), one company, and one battalion).
(b) Normally one, but when the liaison plane is airborne the battalion channel also is required.

Co Comd: (a) Two (battalion and company), but it is desirable to be able to use the platoon channels, which makes a total of six.
(b) One generally, but the tanks also require one to monitor the battalion net when the liaison plane flies over.

Co Comd: (a) Three: battalion, company, and one spare.
(b) One.

3 Plat Ldrs: (a) Three: platoons, company, and battalion.
(b) One plus another for the liaison plane.

QUESTION 8: Have you ever tried to change the channel of any of your nets during an engagement?

Co Comd: Once, but normally it is very difficult. One platoon channel was cluttered up by another tank battalion. We were able to put the platoon on to the company channel, the other platoons of that company fortunately being some way off.

2 Comm O's, 2 Co Comds, and 2 Plat Ldrs: No.

QUESTION 9: How long does it take to set up a channel?

3 Comm O's: A good mechanic takes 5 minutes; an average mechanic, 10 minutes.

QUESTION 10: Is the AN/VRC3 satisfactory technically for tank-infantry communications?

Comm O: Very good. We have not had sufficient power units

for all the sets and have had to use some batteries. This is not satisfactory as the set has to be permanently switched on and the batteries do not last long.

2 Com O's: Yes, very good.

QUESTION 11: Have you had any trouble with the power units?

Com O: The only trouble we have experienced has arisen when 12-volt power units have been put on to the 24-volt supply. I think the power unit is definitiely the answer.

Comm O: If the power supply cable is not properly laid, and it has not been in some tanks, the gun, as it recoils, hits the cable and breaks it.

CO: The virbrators are not sufficiently robust.

Co Comd: No trouble at all.

QUESTION 12: The AN/VRC3 gives communications between the tank and the infantry battalion or company. Is this sufficient, or does the tank also need communication with the infantry platoon?

Comm O: Communications with the infantry platoon are required.

Comm O: I am not qualified to say, but I do know that the company commanders sometimes take a SCR 300 and go forward to the infantry to direct the tanks.

CO: Yes, we definitely need communications with the infantry platoon.

Exec O: We have worked with the British, whose platoon set (the WS 88) has common frequencies with the AN/VRC3. Thus we were able to work to the platoons, which was a great advantage.

Co Comd: We do not, in general, need to talk to the infantry platoon. The tanks should be controlled by the infantry company commander.

Co Comd: Communications with the infantry platoon are often needed. I have on several occasions picked up an SCR 536 (the "walkie-talkie") from the infantry for this purpose.

QUESTION 13: To what extent is the tank telephone used?

Com O: Not as much as it could be, but this is mainly a question of joint training.

Com O: Not much.

Co Comd: Practically the only times have been:
(a) During an approach march, with infantry riding on the tanks, one of the infantryman is given the telephone to hold so that he can talk to the tank commander without the latter taking his headset off.
(b) When infantry are walking close behind the tank, one of them is given the telephone.

Exec O: Not as much as it should be. The telephone should be mounted lower so that the infantry do not have to stand up to use it.

CO: Very seldom, but this is a question of training.

QUESTION 14: What is your opinion of the air support communications?

CO: A tank column, to use air support effectively, must have a controller with the column. We have fitted one tank with a VHF radio for the use of the forward air controller. I should also like a VHF radio in the liaison aircraft since this plane often finds targets.

Co Comd: The liaison aircraft should have a VHF radio for direct communication with the Mosquito and strike aircraft. The ground controller should be in an armored vehicle with the leading elements.

Co Comd: The TACP should be with the leading elements in an armored vehicle which also has both the normal tank radios.

QUESTION 15: Have you any other comments on the communications or communication equipment?

1 Exec O, 2 Co Comds, and 2 Plat Ldrs: (a) To transmit with the present equipment, it is necessary to press two switches simultaneously with different hands; it is difficult to hold oneself in the seat while doing this on the move.
(b) The channel buttons are much too inaccessibly placed at present.

APPENDIX H, ANNEX 2

OUTLINE SPECIFICATIONS OF RADIO SETS

SCR 506	Facilities: CW or voice Signal: AM Power output: 90 w Range: (a) Stationary: CW, 75 miles; voice, 25 miles (b) Moving: CW, 50 miles; voice, 15 miles Channels: Continuous tuning Frequency: 2-4.5 mc Weight: 233 pounds
SCR 508	Facilities: voice Signal: FM Power output: 25 w Channels: 1 transmitter and 2 receivers having 10 preset channels each Frequency: 20-28 mc Use: in command tanks; that is, battalion and company headquarters and platoon leaders
SCR 528	Same as SCR 508 but with only one receiver; used in all except command tanks
SCR 510	Facilities: voice Signal: FM Power output: 1.5 w Channels: 2 preset Frequency: 20-28 mc Use: in liaison planes and originally in company commanders' auxiliary vehicles, but most of the latter have now been replaced by the SCR 508
SCR 300	Facilities: voice Signal: FM Power output: 0.5 w Channels: 40 Frequency: 40-48 mc Use: infantry packset for battalion command net
AN/VRC 3	A vehicular installation of the SCR 300 using a power pack instead of dry batteries

APPENDIX I

EMPLOYMENT OF LAND MINES IN KOREA

Prepared by

Irvin J. Breen

SUMMARY

PROBLEM

1. The problem is to evaluate the employment of land mines in the Korean campaign in the period June 1950 to January 1951.

FACTS

2. The supply of AT mines in FEC was adequate, but AP supply was insufficient for demand.

3. Production of Schu mines in Japan was successfully undertaken.

4. The turnover of troops in FEC prior to the war caused a shortage of land-mine instructor personnel.

5. The ROKA was not trained in land mine usage early in the war.

6. The uncertainty of the tactical situation was considered a deterrent to the use of mines.

7. Enemy mines had considerable success against US armor; enemy use of nonpattern emplacements caused delay and many casualties.

8. Enemy fields were often poorly emplaced, lacking camouflage and concealment.

DISCUSSION

9. It is clear from the mine damage inflicted by both sides that the AT mines in use did not singly have a lethal effect. The UN mine effort was affected by the lack of troops trained in mine usage. This lack can be traced to the large turnover of troops in FEC which meant that trained troops were returning to

SUMMARY

the US while untrained troops were arriving in the theater. This turnover was especially serious in that it kept the supply of seasoned instructor personnel at a low level. The training deficiencies were a factor in the indiscriminate laying of mines, nonreporting of mines, and the nonsweeping of mines which caused damage to our own armor. The UN mine effort was affected often by transport limitations which made it difficult to procure quantities of mines for the troops within the time necessary to support a tactical situation.

10. These difficulties may be reduced to a large degree in the future by the use of remote mine-laying methods such as air, artillery, or rocket delivery. It appears that mines so used could play an important role in the interdiction of enemy rail and road nets. Mining and remining with self-sterilizing mines should be effective. An investigation of the success obtained by the air force with delayed-action bomb interdiction suggests that a like use of land mines would be equally successful. The problem of fast-changing tactical situations, making mines a hazard to one's own troops, is answered by the self-sterilizing mine feature giving the user control over the period during which the mine remains active.

CONCLUSIONS

11. Training in use of land mines by combat arms outside the engineers is inadequate. An insufficient number of personnel trained to emplace land mines were available.

12. Current AT mines in use are not lethal.

13. The reporting of UN mine emplacement was grossly negligent.

14. Earth augers can be used efficiently and satisfactorily in the laying of land mines.

15. Usage of earth augers, and development of remote-lay mine methods would be effective, extending the role of mines beyond that of a mere delay, harassing weapon to a destructive, demoralizing weapon.

16. The current US mine doctrine should be re-examined in the light of enemy operations in this campaign with a view to including successful enemy techniques for possible future use.

17. In view of the enemy performance, the recommendations of the ORO-T-109 report have been confirmed.

18. The enemy wooden box AT mine was effective, causing delay and damage.

RECOMMENDATIONS

19. It is recommended that combat personnel be given adequate training in the emplacement, detection, and recognition of where and how mines can be effectively used.

20. It is recommended that all operations involving emplacement of land mines have either a trained engineer representative on hand, or have personnel present who are able to prepare an accurate record of such emplacements to be forwarded to the division or corps engineer.

21. Depending upon the transportation available, make available to the troops the quantities of mines they request to the fullest extent possible.

22. The use of earth augers to dig holes for emplacing mines should be adopted by the army as one method of mine emplacement.

23. The use of random fields laid in depth is recommended where and when they are tactically feasible.

24. Expedite research and development leading to:

a. Nondetectable AT mines.

b. Lethal AT mines.

c. Antivehicular and antirailroad mines deliverable by remote methods, such as air, rocket, or artillery.

d. Methods for detection or destruction of nonmetallic mines.

e. A mine self-sterilizer.

EMPLOYMENT OF LAND MINES IN KOREA

PROBLEM

The problem is to evaluate the employment of land mines in Korea in the period June 1950 to January 1951.

INTRODUCTION

In order to determine the degree of success achieved in the use of land mines in Korea, there was required the collection of data which would indicate the efforts expended and the results obtained. It should be remembered that enemy armor has not been used since mid-November 1950, and prior to that was generally in retreat for about two months. Thus the enemy was exposed to UN mines during only July, August, and half of September. Unfortunately, the study was handicapped by the lack of obtainable data. This lack made it difficult to determine the numbers of enemy mines used in relationship to US armor casualties, and the extent of damage sustained by the enemy. Furthermore, complete data on UN operations--such as what quantities of mines were emplaced where, when, and by whom--were not being kept. However, the basic data together with special reports for this project and interviews with persons concerned with land mine operations permitted analysis and conclusions.

Korean Terrain and Land-Mine Usage

Korea is a land of valleys between mountains and hill masses. In such terrain, with its limitations, use of land mines can be especially effective. Age-old contour-terraced rice paddies are a severe obstacle to tanks and high-ground-pressure vehicles. Even in dry weather the terrace walls become obstacles. A canal system adds to the difficulty of ground movement. The roads are built high above the fields on either side, varying from four or five to twenty or more feet above. The shoulders are steep with slopes of 45 degrees and more. In only a relatively few areas are relief and mantle rock favorable to deployment of armor. During the part of the campaign discussed here, nearly all friendly and enemy tanks moved along roads. The roads are generally unpaved and have rough dusty surfaces. The road base consisted of crushed stone.

The tests conducted in Korea with earth augers showed that the auger can make the holes for emplacement speedily with a small crew, and that the emplacement can be made relatively undetectable. Each auger can operate as an independent unit carrying up to 50 AT mines on the auger vehicle. One minute added to the digging cycle would cover the additional time required for emplacing any combination greater than one mine.

Exchange Rates

Enemy Exchange Rate

The enemy exchange rate (number of enemy mines used per UN casualty obtained) has been arrived at by using data obtained from I Corps and other data furnished by the Corps of Engineers (see Annex 1). These data indicate an exchange rate between 25 and 50 for those fields that produced casualties. There were enemy emplacements detected and swept without casualties. Statistics on the total enemy mine effort are not available. However, an I Corps enemy mine field report (see Annex 5) prepared for this project shows only 416 enemy AT mines in its area. The 24th Division estimated that it had discovered 900 AT mines (see Annex 1), while the 1st Calvalry encountered 1,451 AT mines (see Annex 1). The over-all total of enemy AT mines used appears to be about 5,000, or about 80 per tank hit. Since the above data are only approximate, to double this would give a favorable exchange rate of 156 mines per casualty. The over-all exchange rate appears to be between 80 and 100 (see Annex 1).

The extensive use of random mine fields was profitable to the enemy. The employment of lethal mines would make the land mine a more deadly weapon.

US Mine Effort

A full evaluation of the US land-mine effort would require data on the extent of damage inflicted on the enemy. Such data have not been obtainable. In the tank casualty survey only one casualty out of 239 was attributed to land mines. However, since the US land mines did not have a lethal charge, the extent of enemy casualties representing tanks hit but repaired is not known. There is one prisoner-interrogation report that cites 25 recoveries.

Again, an expression of the success of UN land-mine effort in terms of number of enemy vehicles hit is inadequate in that there were only 600 to 700 enemy tanks available at the outset of the conflict, and this number sharply declined month by month as a result of UN air and various ground weapons. Consequently, many UN mined areas were not penetrated by the enemy vehicles. A graph of enemy and US armor strengths is given in Figure 1.

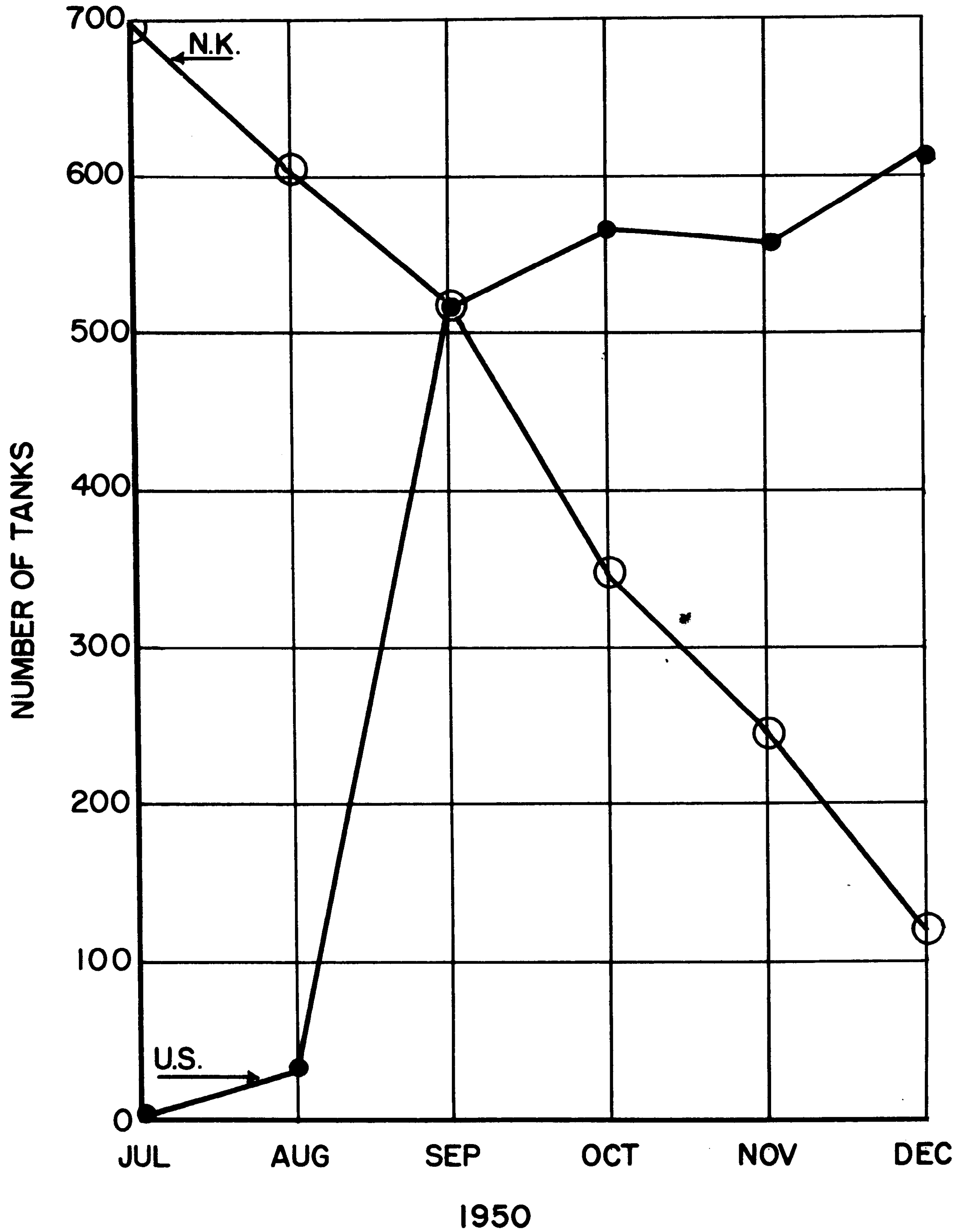

Figure 1.--US and NK Armor Strengths

Also, for much of the period 1 July through 21 January the UN forces were on the offensive and did not employ land mines.

The number of US AT mines issued by ordnance for the period 27 June to 30 November was 123,250. Data on where and by whom most of these mines were used are not obtainable because of the general failure of UN forces to report mine fields.

In view of the fact that data were unobtainable, the number of targets limited, and the UN held the offensive at the time, an exchange rate for UN mine effort (number of mines used per hit) cannot be given, and would not necessarily be meaningful. It is believed, however, that the NK forces employed their mines more effectively than did the UN forces, and that the UN forces did not take full advantage of the suitability of the Korean terrain for antitank mine employment.

Success of Enemy Operations

The chief reasons for the favorable enemy exchange rate were his use of random fields having no easily discerned patterns and US failure to detect or clear mines ahead of tanks. The choice between slow movement at the pace of men probing or trying to detect the difficult wooden box mine, and faster movement at the expense of tank damage was often made in favor of the latter.

World War II Exchange Rates

For comparative purposes, note is taken here of World War II experience. Since terrain and other conditions were different in Korea, this note is not intended to do more than point up the fact that in both the Korean campaign and in World War II land mines have been effectively employed by the enemy.

An average of one out of every five allied tank casualties was due to mines. During large-scale attacks against fortified positions, and in desert and island fighting, the toll often reached two mined tanks out of every five allied tank casualties. As was found in Korea, the land mines were not lethal, only one out of every four or five tanks mined being unrepairable. The average for the British at El Alamein (1942) and the Soviets at Targul Frumds, Romania (1944) was one British or Soviet tank immobilized for every 1,900-2,300 Axis mines. The US in the Aachen-Eschweiler operations (1944) lost one tank for every 220 enemy mines originally laid.

Total Results of Enemy Mine Effort

The detailed breakdown of armor casualties to mines for Eighth Army and X Corps from 1 July 1950 to 21 January 1951 is given in Tables I and II of Annex 2. Land mines accounted for

11.1 percent of the total armor casualties (tanks damaged) from all causes and 7 percent of the total armor losses. The ratio of losses to casualties is 18 out of 64 tanks, only 28 percent, again showing the poor lethality of mines in use.

Table I of this section shows that land mines were in second place as a casualty-producing force, but trailed in fifth place as a loss-producing force.

TABLE I

EIGHTH ARMY AND X CORPS CASUALTIES
(1 July 1950-21 January 1951)

	Total Casualties (Percent)	Total Losses (Percent)
Mines	11.1	7.0
AT gun	4.5	6.6
Tank fire	3.0	4.3
Artillery	1.4	2.0
Mortar	1.4	0.4
Infantry attack	4.0	8.6
Terrain	8.9	18.0
Abandoned	4.0	9.0
Mechanical failure	60.2	41.8

It is important to note that mines produced a larger percentage of total casualties (11.1 percent) than artillery, mortar, antitank, and tank fire combined (10.3 percent). Also even the nonlethal mines in use produced more total losses than tank fire or any other single weapon such as AT guns, mortar, or artillery.

The full discussion of casualties caused by enemy weapons may be found in the main report. The number of such casualties caused by mines, 64 out of a total of 168, indicates the effectiveness of the enemy mine doctrine which gave mines an important place in operations, and directed the use of improvised unpredictable patterns in depth. These mine fields were not necessarily covered by fire.

Enemy success was achieved with a relatively small quantity of mines.

It is evident from these data that instructions to North Korean soldiers regarding antitank warfare were justified. The instructions stated that "mines are the strongest weapons against enemy tanks. Bury mines under sand and dirt when you see enemy

tanks approaching along a road."*

Table II shows that the largest number of tank casualties to land mines occurred before the Chinese entered the war, or prior to 1 November 1950.

TABLE II

ARMOR LOSSES TO MINES BEFORE AND AFTER CCF ENTERED WAR

(Eighth Army and X Corps)

	Before CCF Entry	Since CCF Entry (1 Nov 50-21 Jan 51)
Mine casualties	60	4
Mine losses	14	4

The small number of mine casualties since the Chinese entered the war appears to support the statement of a CCF captain who said that "no land mines, AT or AP as such, were brought by the CCF troops to Korea, but these items were in supply in their homeland. The mines that are being used are improvised from abandoned UN artillery shells, wooden boxes, and cardboard artillery shell containers. The explosives carried by the CCF are dynamite blocks and TNT in crystalline form."**

Each CCF rifle company has three AT "groups." Each group consists of four men--two men carry 20 pounds of crystalline TNT and two carry improvised mines. The mines improvised from expended artillery shells contain 10 pounds of explosive, and those made of cardboard cans contain eight pounds of explosive. Detonators are attached to suit the occasion for use--pull type, pressure type, and time fuzes are employed. In addition, each company keeps three improvised wooden box mines (usually fashioned from ammunition boxes) on hand at all times.

The CCF battle experience as written in a cpatured document*** states that they had no effective weapon against heavy tanks but stated a 20-pound charge of TNT would disable the tread or belly. The belly was cited as the weak spot on a tank. It was stated that an antitank section of four men, two carrying 20-pound TNT

* Allied Translator and Interpreter Section (ATIS) Issue No. 10, 24 August 1950.

** Report Number 6, Headquarters, 533rd Engineer Technical Intelligence Team (Research), 12 January 1951.

*** Document taken by 1st ROK Division and reprinted by EUSAK Office of the Assistant Chief of Staff, G-2, 29 November 1950. This is a translation of a CCF pamphlet on the 39th Army's Unsan battle experience.

packages and the other two carrying 5-pound packages, should be able to immobilize tanks.

Summary of US Armor Casualties

The US armor casualties by mines totaled 64 from 1 July 1950 to 21 January 1951. This was 38.1 percent of the 168 US armor casualties caused by enemy action. Excluding the casualties resulting from tactical abandonment, the mine casualties were 64 out of a total of 145, or nearly as many as from all other enemy weapons combined. Thus mines were by far the enemy's best weapon against US tanks. These striking data are shown in full in Table III.

TABLE III

US ARMOR CASUALTIES CAUSED BY ENEMY ACTION
(1 July 1950-21 January 1951)

	Tank Casualties	
Weapon	Number	Percent
Mines	64	38.1
Antitank guns	26	15.5
Tactical abandonment	23	13.7
Infantry action	22	13.1
Tank fire	17	10.1
Mortar	8	4.8
Artillery	8	4.8
Total	168	100.0

Type of Damage to US Armor

Data on 37 US tanks immobilized by enemy mines or unreported US mines again show the need for a lethal mine.* In most instances the damage was confined to the tracks, shock absorbers, road wheels, sprockets, and brackets. The repairs usually would take from 20 to 30 hours in the unit or battalion. In the few cases where the explosive charges were lethal, the damage and losses were serious. In one case where the lead tank hit four demolition charges, the floor of the tank was ruptured, ammunition exploded, and two of the crew were killed and three wounded. In another case where a dynamite booster was added, the track was destroyed, bottom buckled, torsion bars destroyed, all electrical connections damaged, and linkage torn loose. The tank had to be sent to Pusan for extensive repair.

In some cases the nonlethal damage would still cause the tank to be abandoned or to be a "set-up" for other enemy weapons. In one case the disabled tank was finished off by a thermite

* See Part II, Appendix K, of this report.

grenade; in another case the immobilized lead tank was burned by the enemy; and in a third case a tank with only track damage had to be abandoned. From the wreckage caused by the few lethal mine charges recorded, it is apparent that few of the 37 tanks would have escaped serious damage had a lethal mine been present in every case. In addition, the toll of crew casualties would have had a definite demoralizing effect on tank crews.

These additional data provide further evidence of the favorable exchange rate possible for mines versus tanks. While the tanks can be repaired after most encounters, it remains true that even a temporary loss of so important a weapon as a tank may constitute a serious impairment of strength during a period of action.

For instance, one battle action report states that 4,000 yards beyond Chinju, a lead tank, an M26, was immobilized by an enemy mine. A mine detector squad of the 65th Engineer Combat Battalion removed 11 mines from the road. One-thousand yards farther north, another mine field was encountered which resulted in the immobilization of an M4A3. Three mines were removed from the road. Thus a mere 16 mines had put out of action two tanks even though only temporarily.

The effectiveness of the enemy system of random laying, which was employed in this case, forced the detector team to search over 1.5 miles of road to uncover all the mines. This was costly in time and casualties.

Another battle-action report states that in the vicinity of Oesong-ni a lead tank struck a mine. A reconnaissance-platoon mine-detecting team, working under fire, removed 19 mines and located between 100 and 200 box-type mines along the roadside.

"Armor in the Infantry Division," a report to the Operations Research Office made by Major Robert T. Shaver, Battalion Executive of the 70th Tank Battalion, states that an enemy mine field was encountered which was covered effectively by small arms and artillery fire. A total of 18 tanks were immobilized, 3 of which were not repairable.

Enemy Fields in X-Corps Area

Information about enemy operations in the X-Corps area bears out statements that the enemy achieved delay with his random mine laying even though the mines often were poorly emplaced. They were used in limited quantities during the period under consideration in this report. An exception was in the Inchon-Seoul area where mines were used in defense of road blocks and barricades, and along the Han River. The mines usually were haphazardly placed in obvious haste and often not covered by fire. The 1st Marine Division stated, however, that great delaying effect was

accomplished. In Annex 2 are details of the mine operation and a mine-field overlay of the Inchon-Seoul area.

Enemy Operations

Enemy mine fields caused considerable delay and casualties. The US practice has been to accept the first loss in a mine field not precisely located, then to sweep the remainder of the field. The wooden mines used by the enemy were often difficult to detect and often were located by prodding. Great care was required to pick up wooden mines with detectors. Detection elements had to be held close to the ground. The only safe method is by probe.*

A mine detector is needed which will locate nonmagnetic mines. The presence of a mine detonating vehicle such as a flail tank would have been a great help. Mine fields were most frequently encountered in the vicinity of blown bridges and, after the initial outbreak from the Naktong line, were seldom covered by fire. Mine fields were augmented by AT ditches dug across the roads in defiles.

Further information was obtained from a report of Colonel W. P. Withers, Armor Officer, EUSAK. According to this source, mines were carefully emplaced along the routes of UN advance. They usually were found along the shoulders of roads. They normally blew one track, one sprocket, and broke the supporting brackets. In some instances they blew in, or at least buckled in, one or more escape hatches. Our tank crews suffered only a few minor injuries from enemy mines. Mines claimed the majority of tank casualties caused by enemy action.

Other reports confirm these observations but add that enemy mines were often poorly emplaced, poorly concealed, and easily detected.

Enemy Doctrine

While the enemy achieved his greatest success with random fields, his training and doctrine also provided for patterns. The doctrine is given in Annex 2. The patterns designed for squad AT mine fields and platoon AT mine fields together with the accompanying sketches were secured from POW interrogations. The patterns are elementary, which is an advantage for use by poorly trained troops.

Seven AT patterns were sketched and prepared by the Engineer Section, I Corps (see Annex 2). The irregularity of patterns presents a problem in sweeping. Pattern C, four AT mines stacked in depth, indicates the enemy attempt to deliver a lethal blast.

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* Engineer Technical Information Bulletin Number 2, EUSAK, 24 September 1950.

The enemy lack of pattern also is reported in Special Report Number 2 of the 557th Engineer Technical Intelligence Detachment (for text, see Annex 2). This Report deals with a field found near Kasan-ni which was reported to have no pattern. Also, it was improperly placed and easily seen.

Report Number 20 of the 533rd Engineer Technical Intelligence Team (Research), 14 February 1951, reflects the observations and opinions of Captain Cole of the 556th ETID (C) and also in general the opinions of S-2, I Corps, Engineer Section; 55th Royal Engineer Intelligence; 65th Engineer Combat Battalion, S-2; and several infantry battalion S-2's.

This Report states that from three mine fields investigated by Captain Cole and from perusal of the files of S-2, I Corps Engineer Section, there is no typical enemy pattern indicated. The extent of mine-field doctrine appears to be, as applied to road blocks, "make certain that mines be placed in those spots where heavy traffic is indicated (ruts, tire tracks, etcetera) and on the shoulders of the road; that they be in as much depth as possible, and be staggered so that a vehicle cannot weave its way through without detonating at least one mine; that they be placed in a narrow place in the road such as a cut, or fill, or by-pass; that they be at least covered by rifle fire, and once a mine field on the road has been removed, try to replace it secretly the very next night by use of guerrillas."

It is believed that these patterns are improvised at the time of laying with regard to the terrain, the amount of mines on hand, and the amount of time to do the job.

The Report gives this picture of enemy camouflage. "Most of these fields accomplish one of their purposes very well, that is, to slow our tank columns down and to immobilize them temporarily. Tanks are seldom injured by mines, however, as the mines are very poorly camouflaged. In the cases observed in this area, no attempts at camouflaging had been made except to throw about two inches of loose dirt over the mine, causing a hump in the road at that point and thereby calling attention to it. Dummy holes had been dug, and the dirt replaced without a mine." This was reported to be confusing.

As to fire cover, the fields found in the area had not been covered by AT weapons. There have been riflemen present in the mined area, evidently to prevent hand removal, but on the whole they have been ineffective.

The Report concludes that in forward areas infiltrators will often sneak back the night following removal of the mines and place new mines in the same holes.

The enemy practice of random mine emplacement with no set

patterns actually rewarded his very limited efforts with great success.

Enemy Employment Tactics

The North Korean army reportedly employs land mines in the offense as well as in defense.*

Offensively, mines are said to be used as a harassing agent to demoralize enemy troops, to prevent the enemy from reinforcing his defenses, to ambush enemy units during withdrawal, and to cover friendly troop movements. Furthermore, combat experience reportedly has demonstrated to the Communists that captured positions must be organized and prepared immediately against counterattacks, especially on flanks and salients. It has been indicated that hastily laid mine fields are considered primary methods of defense in this respect.

Defensively, land mines are used to blockade the enemy's positions, to delay or impede his pursuit during a retreat, to destroy his communication lines, to safeguard friendly positions, and to canalize hostile attacks. Canalization of enemy attacks, particularly those supported by or consisting of armored elements, is a fundamental principle of defensive operations within Soviet-trained units. Mine fields reportedly are laid in otherwise penetrable territory canalizing hostile armor into an area where all supporting weapons including AT artillery can be brought to bear on the target.

It has been reported that land mines normally are buried or otherwise installed in certain standard locations. These include the following: enemy frontline positions not advantageous to friendly forces; in the vicinity of fortifications, warehouses, and important buildings; main defense lines and supply routes; between obstacles and around construction projects; approaches to main highways and roads, tunnels, bridges, villages, towns, railroad stations, piers, and fords; under doors and windows of buildings likely to be used as dormitories, assembly halls, or command posts; and in potential rest areas, watering places, and probable camp sites.

It is important to note in the Korean campaign that the enemy placed an extremely low value on human life and operated with an amazingly small amount of transport. In view of this the enemy was well able to use land mines with little or no concern for creating a hazard to his own future operations.

For the UN forces, highly mechanized, to put land mines in all the places the enemy did would create a real danger of future

* Interrogation Reports, Research Supplement, Issue No. 94, 20 Jan 51 (SECRET).

damage to friendly vehicles, or armor, or injury to personnel. Unfortunately, there have been instances where UN forces have incurred damage and injury which, it is believed, have been caused by unreported UN mine fields.

An interesting sidelight on enemy mine operations is presented in ORO-T-7 (EUSAK) where, in the section on "Armor and Infantry," is described the actions of Task Forces Dolvin and Bartlett in OPERATION PUNCH during early February 1951. As stated in this report:

"Persistent enemy mining of the two roads was proving a major annoyance. In some instances, the asphalt had been tunneled under to the center of the pavement. The trigger mechanism of the mine so placed obtruded not more than one-half inch above the surface. In great numbers, mines of two main types had been laid along the road shoulders; 81-mm mortar shells had been bound together in blocks of five and fitted with detonator; besides this improvisation, there were 26-pound blocks of explosive. The work for the most part had been done so hastily, however, that the greater number of mines were covered by only a thin sprinkling of dirt. Except for one day when a fall of snow covered this rather crude field work, no material damage was done to the columns. But every morning there were fresh mines to be cleared away from road stretches which had been free of them the day before. CCF showed a marked preference for the mining of the major defiles, and it was not uncommon to find 50 or 60 mines in one such small area."

Enemy Land-Mine Organization

An engineer platoon is attached to each regiment from its parent organization, the divisional engineer battalion. This battalion is normally charged with the responsibility of laying mines. The engineer platoon, consisting of two squads of 10 men each, is said to be usually equipped with land mines, igniters, and detecting equipment. Reports have indicated, however, that occasionally only igniters are carried and adapted to captured land mines, or they are used as firing mechanisms in improvised equipment. Reports disclose that independent engineer battalions, directly controlled by the North Korean Defense Ministry, have been organized for the purpose of combating invasion. It is reported that five of these engineer anti-invasion battalions were formed with the specific mission to set up defensive land mine areas. Each battalion has a reported strength of approximately 400 men and is said to be equipped with 200 AT mines and an unspecified number of AP mines. The AT mines are made of wood with a detonating pressure of 175 pounds. Reports indicate that the actual supply responsibility rests with the engineer section of corps headquarters, one of whose functions is to channel land mine supplies to division levels. The quantities and types of

mines carried by the enemy have been reported in ATIS publications and are given in Annex 2.

Enemy Mine Types

A list of information on enemy mines and fuzes was compiled from ATIS Research Supplement Number 94 and engineer data. Information on the quantities and types of mines carried by the enemy in seven instances also was secured from ATIS reports and arranged in list form. These lists are presented in Annex 2 along with views of the enemy box mine, a NK improvised AP mine, POMZ-2 AP mine, modified TMD-B, and an improvised CCF mine.

The mines reported to be effectively used by the enemy included: the NK AT wooden mine containing 15.7 pounds of TNT plus a booster; a modification of the TMD-B Soviet mine; the POMZ-2AP shrapnel mine; the US M6 mine; and improvised mines.

Enemy Improvised Land Mines

Improvised enemy land mines, depending on the purpose, usually are cased in tin cans, gasoline or kerosene drums, earthenware, hollowed rock or wooden cases. Earthenware and hollowed stones are reported by US engineers to be most effective against personnel. Four of the most common improvisations are: trip type; tread (or pressure) type; automatic-release type; and shell type.

The automatic-release type is virtually a time bomb and, although difficult to install, can be exploded at any designated time by a mechanical, electrical, or chemical igniter. The advantage of this type of mine is that it is not easily detected and can be buried in advance. The mines improvised by the enemy from shells, which proved to be extremely effective, used artillery, howitzer, or mortar ammunition.

Potential Capabilities of the Enemy

The enemy already has used Soviet-type mines or modifications thereof. Should the land-mine resources of the USSR be placed at the disposal of the present enemy, he could greatly increase his capabilities for land-mine warfare.

The USSR is considerably ahead of the US and Great Britain in the number of types of land mines and fuzes and in their development and production. In World War II, the USSR used approximately 25 AT models and approximately 20 AP models plus improvised mines. It is believed that they now have four standard AT types: the TM-41 (and the TM-44, a larger modification), the TMB nonmetallic tarpaper mine, the TMD-B wooden box mine, and the YAM wooden box mine. The standard AP types are the POMZ-2 shrapnel, the PMD-6 and 7 wooden mine, and the KHF bounding gas mine. This last mine,

although not in use, is believed to be held in stock. The German AT Tellermine and the AP bounding shrapnel mine also are believed to be in production.

The USSR has the mechanical types MUV and VPF pull fuzes and the MV-5 pressure fuze. The electric contact fuzes include the DM vibration fuze and the F-10 radio-controlled fuze.

Current USSR developments are concerned with nonmetallic mines containing increased charges (up to 25 pounds). The need for more lethal, less detectable mines has been expressed elsewhere in this study. The appearance of such mines in enemy emplacements would present a greater handicap to US operations than has been experienced so far.

The use of delayed-action mines and controlled mines detonated by an observer would be likely to produce additional handicaps. It should be recalled that both of these types of mine usage are stressed in Soviet mine training. The potential effectiveness of delayed action mines as an aid to US operations is discussed under "Proposed Innovations in Mine Delivery."

US MINE OPERATIONS

Results of US Mine Effort

An ORO survey of enemy armor losses reported that of 313 tanks and SP guns surveyed only 2 (0.6 percent) were losses caused by mines. As shown in Annex 2 of this appendix, enemy mines caused 7 percent of US armor losses.

Complete information on enemy casualties is of course not available. It is believed that a number of enemy tanks damaged by US mines were repaired and returned to action.

Some data on damage caused by US mines was secured from enemy personnel. A technical officer of the 203rd Regiment, 105th Armored Division, personally supervised repairs to 10 tanks damaged by mines in his regiment and a division technical officer reported 15 mine-damaged tanks repaired in the 107th and 109th Regiments. They said the damage was confined to the tracks and was easily repairable. An ATIS interrogation report* stated that an AT mine would destroy tracks and, when the road was poor, throw tanks off the road. If road conditions were good, the enemy tank stopped at the roadside and soon repaired the tracks.

UN air attack was the greatest single cause of damage to NK T34's. Casualties inflicted by air attack numbered 102 out of 239, or about 43 percent of the total casualties (see Table IV). Napalm appears to be the most effective weapon of all, accounting

* ATIS Issue No. 12, Report No. 1748, p. 137.

for 60 T34's, or about 25 percent of the total count. In the event that the US lacked air superiority or experienced extended periods of unfavorable weather, the burden of effort would be thrown on ground weapons, among which land mines could play an important part.

TABLE IV

COMBINED T34 AND SP 76 LOSSES
(239 T34's and 74 SP 76's)

	Number	Percent
Abandoned	75	24
Napalm	73	23
Tank fire	42	13
Air rocket	24	8
Unknown	19	6
Bazooka	17	5
Artillery	16	5
Strafing	16	5
Bombs	12	4
Air not specified	11	4
Mechanical	4	1.3
Mines	2	0.6
T-6 AC	1	0.3
Self-destruction	1	0.3
	313	100

As previously noted, if allowance is made for the armor damaged but recovered, the total enemy armor casualties to mines is higher than shown in the survey.

That mine-field clearance could cost the enemy delay if not casualties is seen from a report on an enemy engineer battalion clearing a mined area on the Yongdok-Yonghae highway. The mined area was located approximately eight kilometers north of Yongdok. After working all day, only half the area was cleared. The battalion left the job half completed and proceeded toward Yongdok. There were no casualties during the mine-clearing operation.*

Extent of Eighth-Army Mine Effort

From 27 June to 30 November 1950 approximately 123,250 AT and 61,500 AP mines were issued to UN troops in the Eighth Army. These figures do not include the basic load of mines each unit brought with it; this would raise the preceding figures about ten percent.

However, reports made to Eighth-Army engineers accounted

* ATIS Issue No. 6, Report No. 1192, p. 215.

for only a fraction of these mines. The Eighth Army had some 239 reports from its units and 633 spot reports from KMAG for this period. The number of mines accounted for by these reports were 19,529 AP and 13,248 AT mines. These were as follows:

	AP Mines	AT Mines
Covered by Eighth-Army reports	4,431	4,366
Covered by ROK reports	15,098	8,882
	19,529	13,248

Of the Eighth-Army reports, fewer than five were from units other than engineers.

The ROK mine reports generally were inadequate and not sufficiently informative to be very useful. The ROK forces from 25 June to 25 November 1950 laid and later removed these numbers of miees:

Mines	Laid	Removed (US Mines)	Still in Place
AP	15,098	7,815	7,283
AT	8,882	4,040	4,842

Thus approximately 100,000 AT and 40,000 AP mines were emplaced and not reported. The combat arms other than the engineers were the chief offenders. This situation has been a matter of great concern to the Eighth-Army Engineers who indorsed the idea of a self-sterilization device in land mines.* It is not unlikely that the numbers of mines issued run even higher than our figures indicated, since some were issued without any accounting at all. At least part of the explanation for this confusion can be found in the small amount of training in land mines given the combat soldiers and their officers.

The record of the 239 US fields reported is included in Annex 3. The largest mined area reported was in the Naktong River perimeter. Major Edward L. Watts, 3rd Engineer (C) Battalion, stated that there were no cases during the period covered by this report where land mines were tactically decisive in 24th-Division operations. The ROKA also laid many mine fields in the area below Andong-Sangju and east of Kumchon. Within these areas there were many small areas mined so extensively that plotting them on an overlay by coordinates was impractical. Overlays of the mined areas were drawn up by Engineer Intelligence Section, Headquarters, EUSAK, but are not included here, primarily for security reasons.

For the period 14 December 1950 through January 1951 some 57 reports of mine fields were prepared showing about 3,200 AP

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* Major James H. Ball, Jr., G-2, EUSAK Engineers.

and 500 AT mines laid by US engineers. The Eighth-Army Engineers found it necessary to secure data on unreported mines from any likely source. A tabulation of the 57 reports is given in Annex 3. The use of schu mines and improvised grenade mines by the 3rd Engineer Combat Battalion is notable. These fields were laid largely along the Imjin and Han Rivers, and in the areas about Yonchon, Pochon, Uijongbu, Tukto, Changhowon-ni, and Tanyang. ROKA mines were placed largely about the Imjin, Pukhan, Choyang, and Soyang Rivers. A second series of overlays including these areas was prepared by Engineers, EUSAK.

The views of responsible personnel on the use of land mines in Korea were secured for purposes of this study (see Annex 3). They comprise an important part of the record because the convictions of key personnel have a bearing on decisions made about mine warfare. Some of these statements show a generally strong support for the current mine doctrine, especially emphasizing that mines must be covered by fire. The poor training of personnel, poor reporting of fields, and inadequate supply of mines to the front are mentioned repeatedly. There is a widely expressed belief that the enemy's mine operation was poor. Suggested deterrents to the use of mines by UN forces include the fluid state of the tactical situation and the possibility of killing civilians and our own troops.

UN Personnel and Training

The UN forces suffered from a lack of trained personnel during this period (see Annex 4). This limited the attainment of any high degree of skill in emplacement.

By-passes and alternative routes often were left free. In many cases, the mines were not armed. Mine fields were laid without in any way recording their locations; often there was no probing and sweeping of enemy fields.

The current US Army doctrine, providing for set pattern fields to be covered by fire, was generally followed. The enemy used randomly laid fields not necessarily covered by fire. This tended to increase the effectiveness of the enemy's attempts to delay or to damage US armor. The engineers were not always able to divert personnel to extensive mine-field work since they were pressed into service as infantry when the tactical situation was critical.

The Eighth Army prior to the war was handicapped by a lack of space for maneuvers, by occupation duties, and by rotation of troops. These conditions prohibited any realistic training, curtailed the supply of instructor personnel, and made it difficult to build up units of skilled men trained in land-mine warfare who worked together as combat teams. The training program

was hampered further by a lack of training equipment. Officers as well as enlisted men were handicapped by the lack of training.

The ROKA also needed training in land-mine warfare. It was not until 29 June 1950 that any mine training for the ROKA was begun. In July and August, the critical months, only some 300 men had any familiarity with land mines. Despite this lack of training, the ROKA developed skill and emplaced mines with success during the perimeter defense of the Pusan area.

Supply

There was an adequate supply of AT mines in the FEC. The supply of AP mines, however, was insufficient but was supplemented by production of schu mines in Japan. For a table of mines available in FEC, see Table I, Annex 5. The supply going to troops was sometimes hampered by transport limitations. The railroads were not equipped to handle with speed and efficiency the strain placed upon them. The MSR's were under pressure from the movement of other logistics and from troop movements. The movement of land mines from depot to ASP's could be carried out by assigning high priority to the mines. The movement from ASP's to the front was, of course, even more difficult. Table II, Annex 5 shows the ASP stock levels for period 10 September-18 December. Detailed data are lacking on supply and expenditure prior to 10 September. The low levels of AP mines in ASP's is particularly noticeable. While the stocks of AT mines were higher, they dwindled in the critical November-December period without any sizeable replenishments from EUSAK depots. From 26 November to 31 December the ASP stocks of AT mines were never above ten percent of the available depot stocks. After 7 December the ASP stocks of AP mines were a large part of the total stocks in Korea.

The EUSAK depot had sizeable stocks of AT mines on hand for the entire period (see Table III, Annex 5).

The X-Corps AT depot stocks for the weeks 1 November-14 December were negligible for most of the period and rose to less than 4,000 in the last week of the period. The AT stocks were steady from about 3,500 to 6,500 in November and rose steadily from about 4,000 to approximately 44,000 in the first two weeks of December (see Table IV, Annex 5). The X Corps ASP stocks from 23 November to 7 December were negligible for AP mines and the AT stocks were steady at about 8,000. The stocks were not drawn on to any extent during this critical period (see Table V, Annex 5).

Expenditures of land mines were obtained for 10-day periods from 26 June-20 December (see Table VI, Annex 5). The period 26 June-10 September lacks detail. The heaviest expenditures were during the retreat phases. Less than half the total AT mines in Korea were expended during this period (see Table VII, Annex 5).

SUPPLY

The abandonment and destruction of mines during the retreat phase 28 November-15 December indicates the place of the tactical situation as a factor in the use of mines as mentioned in other parts of this report (see Table VII, Annex 5).

During the UN advance, mine expenditures were light, but increased markedly in the November-December retreat (see Table VIII, Annex 5).

As a part of the supply, the schu mine was manufactured in Japan. Late in July orders were placed and early in August they began to be sent to Korea. At an average cost of $1.53, 200,000 schu mines were made under contract (see Annex 5).

PROPOSED INNOVATIONS IN MINE DELIVERY

US Mine Usage

The Korean campaign clearly shows the need for a mine with destructive rather than only damaging ability. In addition, it appears that the employment of land mines delivered by air, artillery, or rocket, as proposed in ORO-T-109, would have been effective. Land mines perfected with respect to self-sterilization, concealment, and penetration could be delivered by the artillery and the air force as part of their normal operations. This would be one alternative solution to the problem presented by the lack of personnel trained to emplace land mines. The transport load also would be relieved since the mines would then not require transportation forward to the front in competition with other logistics. There also would be less risk of capture by the enemy or forced self-destruction of mine supplies. This technique can permit attacks on targets of opportunity and furnish interdiction of the enemy's rail and road nets during the hours of darkness.

An example of a possible effective remote mining can be seen from the 24th Division Record 141800-151800 July: "The fact that friendly air had done no bombing at night has apparently permitted the enemy to keep up the flow of available supplies. He has managed this by avoiding the main roads, hiding, and camouflaging his heavy equipment during the day and moving forward at night."

An enemy armored attack can be delayed by the initial delivery of mines and it can be impeded by re-laid mines in the area through a re-mining operation as extensive as we choose to make it. The self-sterilizing feature also permits use of mines in a fast-changing tactical situation. The delay in sweeping remote-laid mines and actual losses imposed would slow the enemy at night and enable the air force to strike by day.

Performance of Delayed-Action Bombs

An approximation of the effect which a delayed-action waiting weapon can have is seen in the air force usage of delayed-action bombs. A FEAF report* gives the following information:

From 15 to 21 October 1950, B-29's continued the program of dropping delayed-action bombs along the enemy's primary arteries of communications, at bridge approaches, and at important road junctions, further complicating repair of damage previously wrought. During that week, one hundred and seventy-five 500-pound delayed-action GP bombs were sown along 250 miles of key rail and highway communication routes. These bombs are difficult for the enemy to locate, particularly at night, since only a small hole is made in penetrating the ground. Without technically trained personnel it is practically impossible to remove or to destroy them. Fuzes are set to detonate the bombs at intervals varying from one to several hours after impact. Resulting explosions in the vicinity of the mass of laborers used by the enemy to repair damage was calculated to reduce their efficiency in addition to inflicting casualties. Another important consideration is the adverse effect on morale of transportation crews and military personnel forced to travel the lines of communication.

Delayed-action bombs also were used on a pontoon bridge at Seoul in August 1950. On 16 August, sixteen 1,000-pound bombs (four with 6-hour delay and eight with 12-hour delay) were laid in the vicinity of the bridge. A direct hit was made on the bridge. On 28 August, thirty-two 500-pound delayed bombs were dropped near the bridge, which was already out. These were fuzed in the following manner: five with 144-hour delay; six, 1-hour; six, 2-hour; five, 6-hour; five, 12-hour; five, 36-hour; and sixteen non-delay bombs were dropped at the same time to confuse the enemy.** The results, as indicated in the following intelligence reports were good.

A South Korean forcibly engaged in repairing a pontoon bridge in the vicinity of Seoul made the following report:***

1. During the month of July and the early part of August 1950, GP bombs dropped by UN aircraft had only the normal effects, i.e., destruction by direct hits and casualties from bomb fragments.

2. From about mid-August 1950, the use of delayed-action bombs had a highly demoralizing and harassing effect upon NK troops detailed to repair the pontoon bridge. The South Korean further stated that, since delayed-action bombs were not recognized as such, for the first few days casualties were extremely heavy. Later, when this type bomb was recognized, civilian personnel were forcibly used in the reconstruction work. After many were

* FEAF Weekly Intelligence Roundup, 22 October 1950.
** Mission reports, 8th Bomb Squadron.
*** GHQ, FEC, Intelligence Summary No. 2972, 29 October 1950.

killed or wounded, repairing the pontoon bridge was abandoned, and it remained unfinished until after UN troops captured Seoul.

The real merit of remote re-mining lies in its ability to create a continuous disruption of enemy action. It is not enough to knock out his communication lines one time to secure a lasting effect. FEAF intelligence said the following about disruption:* "Even in an undamaged state, available roads and railroads in Korea would be overtaxed by the military traffic necessary to supply an army in the field. Therefore, when subjected to repeated and widespread damage and destruction, the Korean transportation network acted as a very definite limiting and delaying factor on the movement of supplies. Enemy prisoners indicate that in their travels from Seoul to the front they noticed few undamaged bridges and roads; most were either impassable or showed signs of recent destruction. In general, however, it may be said that while the disruption of an already strained transportation network served to slow down the movement of supplies to an appreciable degree, it never caused an abrupt halt. Lines of communication were kept open by ingenious means such as the construction of underwater bridges or by sandbagging the river bottom to a level high enough to permit fording by all types of military vehicles. Rarely, if ever, did the destruction of a road or rail line occasion a delay of more than one or two days in the delivery of supplies. Yet, the continuous delays caused by succeeding obstacles and detours and by the limited capacity of temporary bridges and rail lines constituted a very real brake on the enemy's logistical support of front-line units." (Underscored by writer of this report.)

Delayed-Action Bombs and Land Mines

The use of delayed-action bombs was, then, effective in securing a measure of disruption to the enemy. The air force recognized the need for continuous delay to the enemy. The use of remote-lay land mines by air, artillery, or rocket may very well be a feasible means of obtaining the desired continuous disruption to the fullest extent. Unlike the delay bomb, which is set to explode with or without damage aside from demoralization, the mine will await its victim and then detonate. Mines should have an effectiveness very much greater than that of delayed-action bombs.

Use of Earth Auguers

The Operations Research Office made a proposal for the use of AT mines to be laid in depth using power earth-augers. The use of earth augers was suggested as a means of getting numbers of AT mines emplaced with speed using a limited force of men. Following up this proposal tests were conducted in Korea to determine the installation performance of the earth augers and the detectability of the emplaced mines from air photographs.

* FEAF Intelligence Roundup No. 11.

These tests (described fully in Annex 6) established that earth augers can be used on and off roads efficiently and satisfactorily in the laying of mines. Each auger can operate as an independent unit carrying its own crew and a load up to 50 mines. On an MSR (six to eight inches of gravel or crushed stone), ten mines can be planted per hour; on secondary roads (four inches of packed silty clay), the rate is 18 per hour; on sand flats, 40 per hour; and on paddies and flood plains, also 40 per hour.

The random method of planting mines was found to be much more difficult to detect than a regular pattern. Also it was determined that a mine covered by dry material obtained from the road surface was more difficult to detect than one covered by moist soil taken from the hole. The excess soil was disposed of in ditches. For the placement of additional mines or charges in a hole, very little extra time was required to dig the deeper hole. One minute added to the digging cycle will cover the additional time required for any combination greater than one mine. By comparison with the earth-auger performance, three Koreans using hand tools were able to make only two emplacements of single mines per hour. Further, the use of hand labor on multiple plantings or a mine supplemented with dynamite was not practical on an MSR.

CONCLUSIONS

1. The turnover of troops in FEC prior to the war meant that trained troops were returning to the US while replacements were largely untrained. There was a lack of seasoned instructors available for training, and a lack of training facilities and equipment. The training time devoted to land mines for both EM's and officers was very brief in the United States. In view of the above and since land mines were often laid indiscriminately in Korea, not reported, and often not probed for and cleared, it is concluded that the training in use of land mines by combat arms outside the engineers is inadequate.

2. Since only two out of 313 of the enemy armor surveyed were total losses caused by land mines and since the US recovered 46 out of 64 casualties it is concluded that the current AT mines in use are not lethal when used singly.

3. Actual field tests demonstrated that earth augers can be used in the emplacement of mines efficiently and satisfactorily. The auger vehicle can operate independently, carrying the crew and supply of mines. The mines can be emplaced with speed and made difficult to spot. The holes can be dug to any desired depth for multiple emplacements. In view of the successful tests, it is concluded that earth augers would be effective in mine-field work. The Korean war showed the need for a continuous interdiction of the enemy's supply lines and routes of advance. The use of delayed-action bombs was effective in

CONCLUSIONS

disrupting the enemy. It is concluded that the development of remote-lay mine methods such as air, artillery, or rocket delivery would extend the use of mines beyond that of a mere delaying, harassing weapon to a destructive, demoralizing weapon.

4. Since the enemy exchange rate using randomly laid fields, no set patterns, often in depth, and not necessarily covered by fire was 80-100 mines per casualty, it is concluded that the current US mine doctrine should be re-examined in the light of enemy operations in this campaign with a view to including successful enemy techniques for possible future use.

5. In view of the enemy performance, the conclusions of the ORO-T-109 report on land mines have been substantiated.

6. The enemy wooden-box AT mine was effective in causing delay and damage.

RECOMMENDATIONS

1. It is recommended that combat personnel be given adequate training in the emplacement, detection, and recognition of where and how mines can be effectively used.

2. It is recommended that all operations involving emplacement of land mines have either a trained engineer representative on hand, or have personnel present who are able to prepare an accurate record of such emplacements to be forwarded to the division or corps engineer.

3. Depending upon the transportation available, make available to the troops the quantities of mines they request to the fullest extent possible.

4. Nondetectable AT land mines having a lethal charge should be developed for standard use.

5. The use of earth augers to dig holes for emplacing mines should be adopted by the army as one method of mine emplacement.

6. The use of random fields laid in depth is recommended where and when they are tactically feasible.

7. Expedite research and development leading to:

a. Nondetectable AT mines.

b. Lethal AT mines.

c. Antivehicular and antirailroad mines deliverable by remote methods, such as air, rocket, or artillery.

d. Methods for detection or destruction of nonmetallic mines.

e. A mine self-sterilizer.

APPENDIX I, ANNEX 1:

EXCHANGE RATE: ENEMY MINES AND US CASUALTIES

Enemy

Following is a tabulation of US losses to NK mines up to 1 October 1950 as reported during a field survey.

Organization	No. Tanks Mined	No. Mines	Mines/Tk	Est Time Repair (days)
1. D Co 6th Tk Bn	1	20	20	5
2. B Co 6th Tk Bn	4	--	--	?
3. A Co 6th Tk Bn	7	--	--	3 plus
4. C Co 6th Tk Bn	3	--	--	3 plus
5. 89th Tk Bn	3	33	11	?
6. 73rd Tk Bn	2	150	75	20 plus
7. A Co, 73rd Tk Bn	2	66	33	killed
8. 70th Tk Bn	32	--	--	2 plus
Sum for 1, 5, 6, 7	8	269	Av. 34	Av. 3 plus

The exchange rate, mines per tank casualty, appears to be between 20 and 50 averaged over all casualties.

The reported data from I Corps showed:

Organization	No. Casualties	No. Mines	Mines/Casualty
1. 3rd EC Bn	1 tk	29	29
2. 3rd EC Bn	1 tk	9	9
3. 3rd EC Bn	1 tk	12	12
4. 72nd EC Bn	1 truck	8	8
5. 14th EC Bn	1 tk	10 plus	10 plus
6. 3rd EC Bn	1 tk	10	10
7. 3rd EC Bn	1 jeep	9	9
8. 65th EC Bn	1 vehicle	4	4
Total	8	91	Av. 11+

This indicates an exchange rate in these encounters averaging more than eleven.

ANNEX 1

Three encounters cited in Appendix K of this report show:

	No. Casualties	No. Mines	Mines/Casualty
1. 65 EC Bn	1 tank	12	12
2. 65 EC Bn	1 tank	4	4
3. --	1 tank	100-200	100-200

The average exchange rate appears to be between 40 and 70.

The Over-all Enemy Exchange Rate

The tank casualties per division are known and the approximate numbers of enemy AT mines used against the 24th and 1st Cavalry Divisions, which two divisions sustained over 58 percent of the total casualties, were furnished for this report.

Division	Tank Casualties	No. AT Mines	Exchange Rate
1st Cavalry	24 (4)	1451	61
24th Division	13 (5)	900	69
total	37 (9)	2351	64 (average)

Assuming the other divisions' tank casualties were caused by a proportionate number of mines, a reasonable estimate would indicate that the enemy used some 5,000 AT mines during the period. This gives an exchange rate of about 80 mines per hit secured. Even to double this to 10,000 AT mines, an unlikely case, would still give a favorable exchange rate. The over-all exchange-rate appears to be between 80 and 100 mines per hit.

APPENDIX I, ANNEX 2:

ENEMY MINES AND MINE OPERATIONS

Enemy Mine Fields

Data were secured especially for this project from I Corps for the period 27 June-25 January 1950. These data furnished details on 26 mine fields laid by the enemy in I-Corps areas; this is the total of all the enemy mine fields reported by I-Corps units. The data are listed on the following pages.

These 26 mine fields contained 416 AT mines of which 75, or 18 percent, were US M6 mines. Four of the 26 fields had no numbers of mines given. The range of mines per field ran from 8 to 90, the average field having 19 mines. There were 7 fields having fewer than 10 mines emplaced.

Of these 26 mine fields, 11 (42.3 percent) were reported to have inflicted casualties to UN personnel or equipment; an equal number caused no damage; and for 4 mine fields (15.4 percent), the information was either unreported or listed as "unknown."

The damages inflicted in the 11 effective fields and the mine effort in each case was as follows:

Casualties	No. of Mines
M46, 3 pieces of track and outer half of bogie wheel	29
1 tank track blown	9
2 WIA and 1 D-7 track	12
3 WIA and 1 jeep	unknown
1 truck damaged	8
1 KIA, 1 WIA	50
D-7 damaged	11 or more
M46 tracks damaged	10
1 jeep damaged	9
1 British vehicle	4

Thus about 142 AT mines immobilized nine vehicles, killed one man, and wounded six. At $16.60 per AT mine, using the estimated 1950 mass production figure for the M6A1 mine, this

I CORPS REPORT ON ENEMY MINE FIELDS

(27 June 1950 through 25 January 1951)

	Location--Grid Coord & Terrain Features	No. of Mines	Number Removed	Type Mine	Pattern & Tactics Used, Number Booby Trapped	Effectiveness of Mines	Lessons & Remarks	Personnel & Vehicle Casualties
1.	1120.3 - 1440.7 Open terrain & defiles (3rd ECB)	22	22	AT Wooden Box Type	Covered by AT guns & Arty. In roadway in groups of 4 in staggered pattern, rows 13 ft apart. In repaired bridge abutments, in grassy sections of road under straw, in gravel & grass of river bottom. Mines barely covered and about 2 in. above ground in some cases.	Poor	--	none
2.	1061.3 - 1490.5 In defiles (3rd ECB)	15	15	AT US M-6	No pattern, but buried according to US tactics. No booby traps - wells still taped. Covered by AT guns.	Poor	Enemy placed additional 120-mm mortar powder in fuse well	none
3.	1135 - 1448 On shoulders of road (3rd ECB)	29	28	AT US M-6 & wooden box	Buried 1 in. below surface in double rows at natural obstacles; rows 3 ft apart & staggered covered by mortar and SA fire.	Good	Enemy seems to believe that SCR 625 is ineffective against wooden box mines	M-46 lost 3 pieces of track & outer ½ of bogie wheel
4.	1230.1 - 1465.0 In bypass thru river bed (3rd ECB)	9	8	AT US M-6	Pattern similar to "B" (see attached sketch) 3 ft between mines, 4 ft between rows, 0 to 6 inches deep.	Good	--	Blew track off one tank.
5.	DQ 2284 (approx) In by-pass (3rd ECB)	12	11	AT wooden box	Pattern similar to "F" 4 across rd, 4 on approach, 4 in abutments, up to 20 in. deep.	Good	--	2 WIA and D-7 track
6.	CT 093005 near old ferry landing (3rd ECB)	16	16 Blown	AP POMZ-2	No pattern, set on stakes w/trip wires attached.	Poor	---	None
7.	MSR YULI (BU 6205) to SANGWON (BU 4803) (Engr, 1st ROK Div)	36	36	AT Most TMD-B box type	Patterns "D" "E" & "F"	Unknown	Pattern "D" described by captured enemy Engr Co CO as pattern taught at Engr school	Unreported
8.	MSR SANGWON (BU 4803) to TAEDONGNI (BU 4010) (Engr, 1st ROK Div)	90	90	AT circular metal type	Pattern "G" top of mines about ½ in. above ground level.	Unknown	Some picked up by detectors, some by poor camouflage or burial.	Unreported
9.	1097 - 1446 Terrain not reported (11th ECB)	Unknown	None	AT US M-6	Pattern not determined	Good	--	3 WIA 1 jeep

I CORPS REPORT ON ENEMY MINE FIELDS (continued)

Location--Grid Coord & Terrain Features	No. of Mines	Number Removed	Type Mine	Pattern & Tactics Used, Number Booby Trapped	Effectiveness of Mines	Lessons & Remarks	Personnel & Vehicle Casualties
10. 1139.5 - 1450.3 In creek bed used as lateral supply road (72d Engr C Co)	8	7	AT Wood box type	Pattern "B" mines not booby trapped, no covering fire. Easily removed.	Fair	---	1 truck damaged
11. MSR 1138.0 - 1454.4 to 1139.0 - 1460.5 (72d Engr C Co)	30	30	AT 24 wood box, 6 US M-6	No pattern, placed usually at curves in groups, ea mine about 10 yds apart and staggered from one side of road to other, characterized by loose dirt and mounds. One booby trapped by tying string around mine and attaching to hand grenade pin, beneath mine.	Poor, easily spotted and removed.	Mines often have no pattern, may be booby trapped, therefore induce caution & slow up removal	None
12. On MSR approx DQ 2695 Series of 6 fields (72d Engr C Co)	50	50	Wooden box	Fields laid on enemy side of curves in rd. Covered by MG's and AT guns. Pattern "B" none booby trapped.	Excellent: Tanks could not by-pass because of high shoulders and difficult terrain. Mines could not be removed until enemy resistance removed.	Care required to pick up wood mine with detector. Detection element must be held close to the ground. Mines can be detonated with 50 cal. fire but not with 30 cal.	1 KIA 1 WIA
13. Not reported (72d Engr C Co)	4	4	US M-6	One on top another in pattern "C".	Unreported	Lifting details must be sure to remove all mines	none
14. On road vicinity XE 9908 (3rd ECB)	8	8	Wood box	Pattern "A" buried flush with ground level, lightly covered with dirt.	Poor	---	none
15. On road YE 3832 (Engr, 1st ROK Div)	Unknown	Unknown	Chinese	Laid in conjunction w/AT in ditch & covered by SA fire. Pattern unknown. Ground not taken, field may still exist.	Excellent	Few mines removed were turned over to TIT for analysis	unreported
16. YD 5515 Shoulders of rd at by-pass (14 ECB)	Unknown	8	AT Circular metal type	No pattern, buried on rd bed shoulders, poor camouflage.	Impeded progress somewhat	---	none

I CORPS REPORT ON ENEMY MINE FIELDS (continued)

	Location--Grid Coord & Terrain Features	No. of Mines	Number Removed	Type Mine	Pattern & Tactics Used, Number Booby Trapped	Effectiveness of Mines	Lessons & Remarks	Personnel & Vehicle Casualties
17.	BT 8564 In river bed and bank near by-pass (14 ECB)	Unknown	10	AT wood box	Pattern unknown. Hasty, poor camouflage.	Good	--	D-7 Damaged
18.	XE 9908 along rd, 15 Nov 50 (3rd ECB)	16	16	AT wood box type, NK	Mines laid 2 abreast in ruts of rd, 2 more abreast 4 ft farther on the rd - 4 laid in same pattern 200' farther down rd. Two of these 8 pattern fields laid in same area.	No exact terrain features used--not covered by fire	none	none
19.	YE375019-laid beyond a pass on straight stretch of rd just before approaching a curve. 15 Nov 50 (3rd ECB)	10	7	AT wood box type, NK	Mines laid in 2 groups of five 2 abreast on shoulders of rd, 1 in ctr of rd, 2 abreast in ruts of rd, forming an X.	Not covered by fire, good use of tertain features, fair effect.	Some of mines not covered— showing hasty withdrawals	3 mines exploded by M-46 tank damaging both tracks, but did not put tank out of operation
20.	On rd between YE 276082 & YE 273084 16 Nov 50 (3rd ECB)	9	8 (3 pulled, 5 blown in place.)	AT US M-6 and M-7*	One pulled mine was booby trapped. Others believed to have been booby trapped.	Good	US mines used and booby trapped to go off when mine was pulled	1 jeep damaged
21.	YE395065, 20 Nov 50 (8th ECB)	20	4	AT wood box, NK	None	None	Mines laid in haste, easy to find	Unknown
22.	YE440044 along rd to YE435070 20 Nov 50 (8th ECB)	21	21	AT wood box, NK	None	None	Mines laid in haste, were easy to detect	None
23.	BT816083 in plowed field on side of rd 10 Dec 50 (65th ECB)	4	3	AT wood box, NK	No pattern reported; were laid much earlier during our advance in Oct 50.	Good (on our withdrawal)	---	One British vehicle
24.	BS9775 along beach east side of Han R. about 15 Dec 50 (65th ECB)	Unknown	Unknown	Unknown	Not reported	---	---	None
25.	CS590358 along rd just S of rd tunnel 21 Jan 51 (72d ECCo)	5	4	AT US M-6	No pattern-field laid last fall	None	None	1 Korean civilian
26.	CS280029 on two knolls 18 Jan 51 (10th ECB)	Unknown	None	AP	Not reported; minefield laid during our advance last fall	None	None	None

* Lot numbers LOP 6-89 & LOP 5-3. Fuzes were of M-6 & T-8 type w/M-1 activators.

effort cost some $2,357 for the damage produced. The actual damage, while not heavy, still was clearly worth the effort. Considering the factors of psychological and tactical delay, the results are also very favorable. Further, if the land mines had been such that the damage would have been lethal, the cost exchange rate would have been extremely high, the three tanks alone costing more than half a million dollars.

Location of Mine Fields

The largest number of mine fields (12) was emplaced on the roads and road shoulders; by-passes (6) were the second leading locations; open terrain (3); defiles (2); and a ferry landing (1).

Emplacement

The enemy fields often were laid in haste and consequently poorly emplaced. Only five were reported as covered by fire and eight were remarked on for their extremely poor concealment. Furthermore, in ten fields there was no pattern. This induced caution and slowed removal especially when mines might be booby-trapped as reported for field No. 11. The use of nonpattern emplacement impeded progress, as was remarked for field No. 16. During this period, the enemy made no serious attempt to do more than annoy and delay UN forces with land mines.

Even though this lack of pattern was possibly due in some cases to hasty emplacement, the result was the same as if the nonpattern fields had been carefully planned, for they effectively impeded the US rate of advance.

X-Corps Enemy Fields

Although the preceding data indicate that the enemy achieved much success with land mines, his effectiveness was fortunately reduced by the many instances of extremely poor emplacements. One example from X Corps (see Special Report No. 2 of 557th ETID following this section) gives account of a field discovered by 8th ROK engineers near Kasan-ni. This field, emplaced in 5 sections, had 82 AP mines laid in the natural approaches of reconnaissance troops or patrols. There were no patterns used. This could have been deadly effective. However, they were improperly placed, badly concealed, not buried properly, and not activated. The 8th ROK engineers have deactivated some 2,100 mines without a casualty.

Also in the X-Corps area, the enemy used mines in the Wonsan-Hamhung area to a very limited extent. Quantities of AT mines were discovered by ROK forces on the beach at Wonsan and were removed. Large stocks of partially completed mines were found in a factory in Wonsan. They were the wooden AP mine PMD-6 or

ANNEX 2

TABLE I

EIGHTH-ARMY AND X-CORPS ARMOR CASUALTIES* CAUSED BY MINES
(1 July 50--21 January 51)

Eighth Army			X Corps		
Division	Unit	No.	Division	Unit	No.
1st Cav	70th Tk Bn	24 (4)	1st Marine	1st Tk Bn	7 (1)
24th Div	6th Tk Bn	4 (1)	7th Div	73rd Tk Bn	2 (0)
	Tk Co, 5th Inf	8 (3)	3rd Div	Tk Co, 15th Inf	1 (1)
	Tk Co, 21st Inf	1 (1)			
25th Div	89th Tk Bn	5 (3)			
	25th Recon Co	1 (0)			
2nd Div	72nd Tk Bn	7 (1)			
	2nd Recon Co	1 (0)			
	Tk Co, 23rd Inf	1 (1)			
	Tk Co, 38th Inf	2 (2)			
	Tk Co, 9th Inf (information incomplete)				

Eighth Army Total Armor Casualties to Mines	54 (16)	X Corps Total Armor Casualties to Mines	10 (2)
Eighth Army Total Armor Casualties from All Causes	423 (193)	X Corps Total Armor Casualties from All Causes	153 (63)

Combined Total Casualties to Mines	64 (18)
Combined Total Casualties from all Causes	576 (256)
Percent Total Casualties Caused by Mines	11.1
Percent Total Losses Caused by Mines	7.0

* Figures in parentheses represent complete losses.

TABLE II

CASUALTIES AND LOSSES TO LAND MINES BY TANK TYPE
(1 July 50--21 January 51)

Type	Number Committed	Casualties* Number	Casualties* Percent
M26	252	24 (3)	9.5 (1.2)
M4A3	516	33 (14)	6.4 (2.7)
M32	71	2 (1)	2.8 (1.4)
M24	113	2 (0)	1.8 (0.0)
M46	173	3 (0)	1.7 (0.0)
M45	8	None	None

* Figures in parentheses represent complete losses.

schu mine. No other mine fields of significance were uncovered until I Corps ROK engineers located a large AP field on the beaches north of Songjin. Over 800 POMZ-2 AP mines were removed in this area. Mines have been discovered along road shoulders, in ditches, and along the main routes of advance. The enemy effort, again, was offset by his lack of camouflage.

An AP field consisting of 170 AP shrapnel mines, POMZ-2 with pull fuze MUV, was discovered and removed by X-Corps units along the beach south of Inchon. The mines were placed in low vegetation to provide concealment. One trip-wire from each mine was placed parallel to the beach and extended past the adjacent mine to stakes driven in the ground. Camouflage again was not effective and they were easily discovered and removed. The field was booby-trapped by fastening wires to the bodies of two enemy dead, a canteen, and a field pack.

According to X-Corps engineers, throughout the Inchon-Seoul area the enemy employed mine warfare in a limited and haphazard manner and used mines for their nuisance value rather than to improve the enemy's tactical situation. An exception to this rule occurred in Seoul where both AT and AP mines were extensively employed in the defense of road blocks and barricades. All major street intersections were heavily mined and covered by fire.

Likely crossing sites on the Han River near Seoul were mined with the wooden box mines and POMZ-2 AP mines. These were laid in a great hurry and were poorly camouflaged. In the Seoul-Inchon area the 1st Marine Division reported much enemy mining activity.

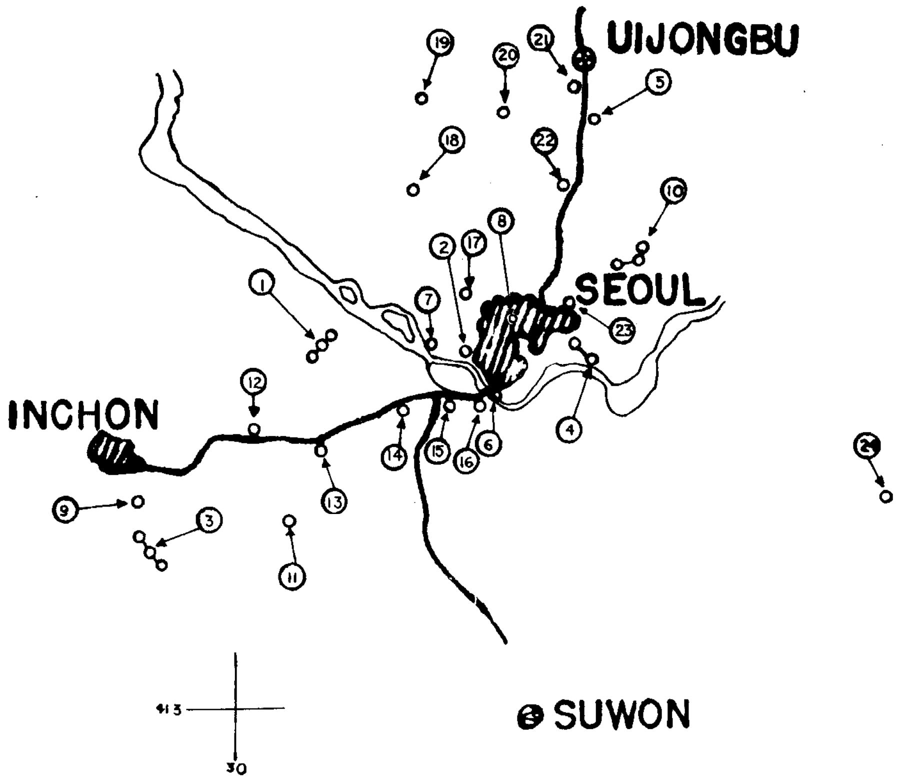
The following is an abstract from a 1st Marine Division Special Action Report, Inchon-Seoul, 15 September-7 October 1950.

"Where his (the enemy) defense centered around a principal road, as it did along the Seoul-Inchon highway, the enemy laid extensive mine fields that served to retard our advance. It is significant, however, that most mine fields were hastily prepared, sometimes camouflaged and sometimes merely laid on top of the ground, and very rarely covered by enemy fire. The mines themselves were either antivehicular or antipersonnel and of either wooden or metal construction. Especially in Seoul did the enemy cover his retreat from the city by mining thoroughly all routes of advance which we had to use."

D plus three "enemy road mining activity increased, slowing down our forward movement."

D plus four "movement along the roads was retarded by the frequency of hasty enemy mine fields."

D plus ten "his (the enemy) defense further complicated our



KEY

1. AP & AT MINES RPTD 21 SEP (1M)
2. AP MINES RPTD 30 SEP (19 GP)
3. AP MINES RPTD 18 SEP, CLEARED 1 OCT (7D)
4. MINES RPTD 2 OCT, CLEARED 3 OCT (1M)
5. AT MINES RPTD 2 OCT (1M)
6. AT & AP MINES RPTD 3 OCT, CLEARED 3 OCT (7D)
7. AT MINE ROAD BLOCK RPTD 3 OCT (7D)
8. MAIN STREET INTERSECTIONS MINED IN SEOUL RPTD 26 SEP (1M)
9. AP MINES RPTD 3 OCT (3rd Log Comd)
10. CIV RPTD U/I MINES 3 OCT (1M)
11. AT MINES RPTD 18 SEP (1M)
12. AT MINES ON ROAD RPTD 18 SEP (1M)
13. AT MINES ON ROAD RPTD 18 SEP (1M)
14. AT MINES RPTD 21 SEP (1M)
15. AT MINES RPTD 20 SEP (1M)
16. U/I MINE RPTD 29 SEP (1M)
17. AT MINES ON ROAD RPTD 25 SEP (1M)
18. U/I MINE POW RPTD 29 SEP (1M)
19. AP MINE RPTD 1 OCT (1M)
20. U/I MINES RPTD 1 OCT (1M)
21. AT & AP MINES, APPROACH TO UIJONGBU RPTD 2 OCT (1M)
22. AT MINES, CIV RPTD 28 SEPT (1M)
23. U/I MINES, NORMAL SCHOOL, SEOUL RPTD 3 OCT (17 ROK)
24. U/I MINES CIV RPTD 30 SEP (7D)

LEGEND

o-o-o MINE FIELD

▬ 1st CLASS ROAD

X CORPS

ENEMY MINE FIELDS X CORPS AREA

MAP: KOREA 1:250,000 Sheets J 52 M,N

PREPARED BY S-2 SECTION

advance by extensive mine fields which were placed both deliberately and haphazardly along the routes of approach and in all conceivable locations bordering the roadways."

D plus 16 (Seoul-Suyuhyon road) "Resistance during the day consisted of numerous mine fields along the route of advance ... The enemy mine fields which were encountered had been set up hastily and consisted for the most part of antipersonnel mines located along the road and in adjoining fields."

D plus 18 (Uijongbu-Seoul axis) "The enemy was still trying every method to hold up our advance toward the town of Uijongbu. His mine fields were extensive along the main road and were well enough covered by fire near the outskirts of the town to hold up clearing activities by engineer personnel."

1st Engineer Bn "The removal of land mines was a major problem of the letter companies during this period. Booby-trapped mines and AP mines were found and removed."

Patterns "Some roads in the corps area were mined, but no definite pattern could be ascertained. Some of these mine road blocks were defended, but the majority were merely laid in the open, on the roads, and then abandoned."

Enemy Doctrine

Although, as has been noted elsewhere in this report, the enemy did not adhere to established doctrine, his training nonetheless provided for certain elementary patterns. It should be emphasized that these patterns were not considered inflexible but rather were used as a basis for improvisation.

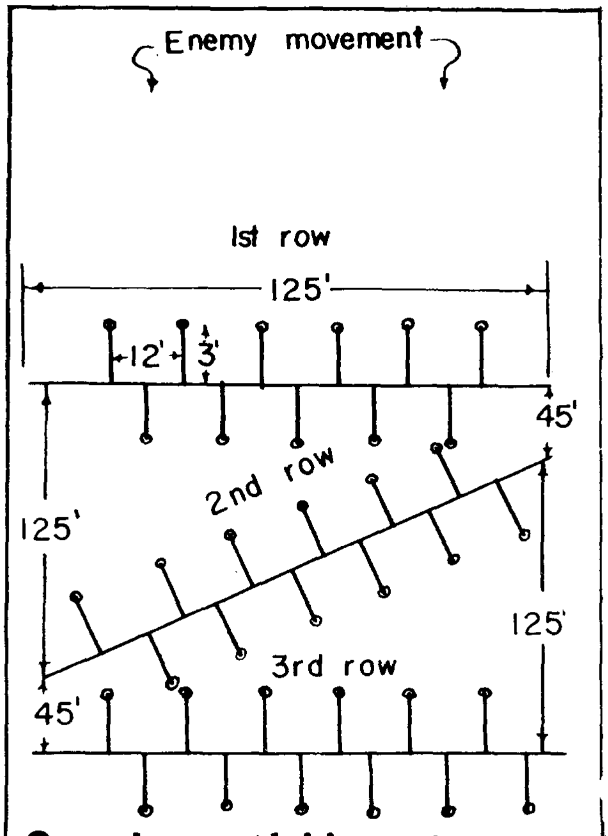
The following information on enemy doctrine was published in Engineer Technical Intelligence Bulletin No. 6, 18 November 1950 (EUSAK).

NKPA Squad Antitank Mine Field Pattern

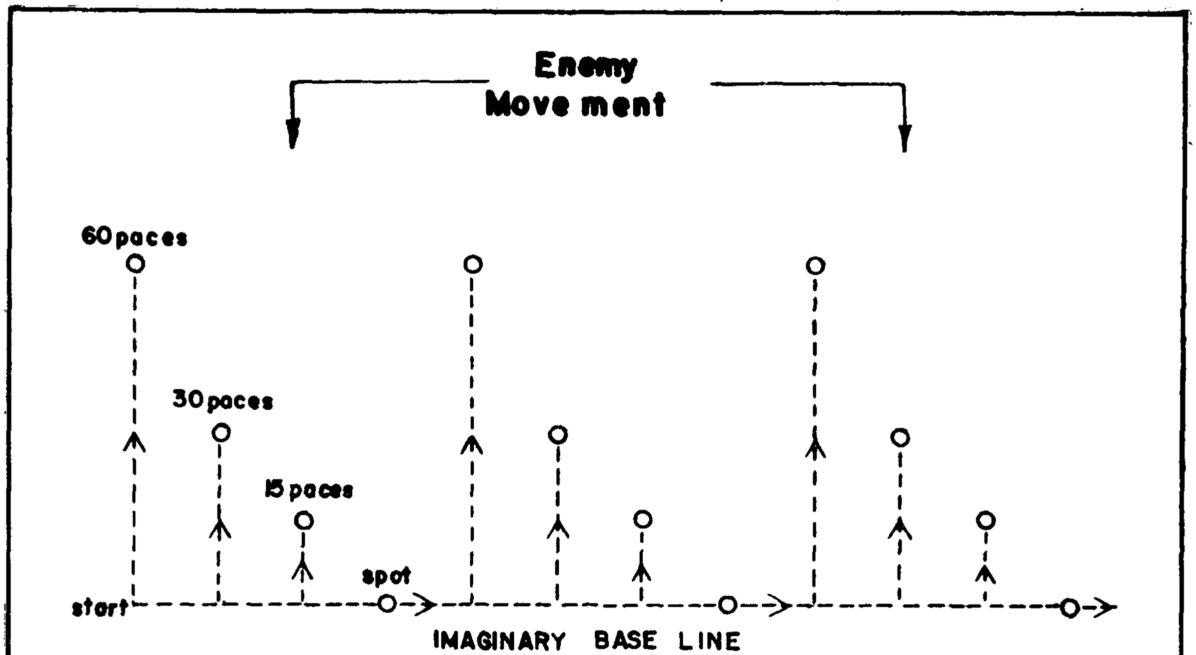
Source: Prisoner of War Interrogation (ADVATIS Report).

Description: Pattern was designed specifically for use by small groups of men such as a squad or section for laying antitank fields on roads or open terrain. Method used is to take a rope approximately 125 feet long and attach 10 to 15 mines along this rope. The distance between mines is varied from 9 to 12 feet and the short rope used to attach the mines to the long rope is approximately 3 feet long. The long rope is then stretched perpendicular to the advancing enemy and after the mines are correctly laid out the ropes are removed and the mines buried approximately 1 inch below ground level. If additional rows of mines are needed a second string of mines is laid diagonally using the

ANNEX 2

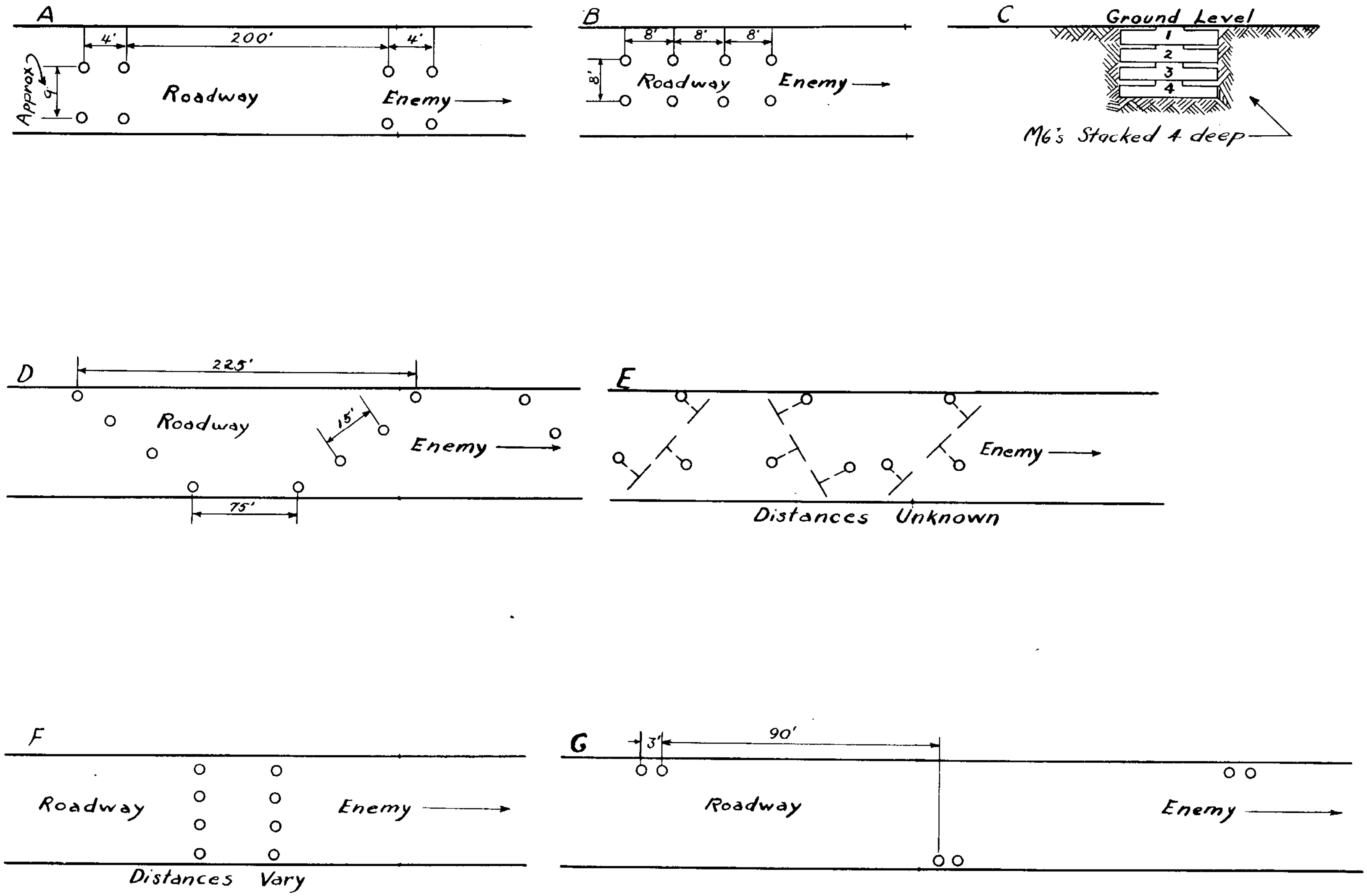


Squad minefield pattern



Platoon Anti-tank Pattern

REPORTED MINEFIELD PATTERNS USED BY N.K.P.A.



PREPARED BY: ENGR. SECT., I CORPS
13 NOVEMBER, 1950

same procedure as outlined above, but using a point 45 feet to the rear of either end of the previously laid row of mines as a starting point. The long rope is then stretched out so that the other end is 125 feet from the first row of mines. Additional rows may be laid by reversing the diagonal line.

NKPA PLATOON ANTITANK MINE FIELD PATTERN

Description: Pattern was designed specifically for use by platoon-sized groups of men laying antitank mine fields in open terrain. To lay fields an imaginary line is drawn perpendicular to the advancing enemy and mines paced off along the anchor line 12 feet apart for the desired distance of the mine field. The first mine is then picked up and paced off 60 paces in the direction of the enemy, the 2nd mine is paced off 30 paces, the 3rd 15 paces and the 4th is left on the line. This is repeated in fours until all the mines are laid. The distance mines are paced off toward the enemy is not a hard and fast rule but is varied to suit the terrain and enemy situation.

Conclusions: Patterns are elementary in nature which is in itself an advantage since they can be easily used by poorly trained troops. The squad pattern would be effective if laid in depth, however the platoon pattern which has no provision for depth should prove ineffective.

HEADQUARTERS

557th ENGINEER TECHNICAL INTELLIGENCE

DETACHMENT APO 301

Special Report #2 30 January 1951

ENEMY MINE FIELD

SOURCE

As per instruction from X Corp Engineer this organization investigated an enemy mine field near the town of Kasan-ni (DR392818). Said mine field had been discovered, deactivated and destroyed by the 8th ROK Engineers before the undersigned arrived (1500 hours 26 Jan 51) at the stated site. The information as reported herein was supplied by Lt. Clark, American Adviser to that organization.

GENERAL DESCRIPTION

The mine field described by Lt. Clark consisted of Russian Hand Grenades (similar to the RPG-43 Heat) rigged with trip wires as antipersonnel mines.

SPECIFIC DESCRIPTION

The mine field contained five (5) sections and no two sections were alike in so far as measurements or pattern were concerned.

The sections consisted of the following number of antipersonnel Hand Grenades connected with trip wires ranging from 7 to 25 feet in length.

Section	Location of Center	Number	Direction (Grid Azimuth)	Length
1	DR383817	33	N 75 E	Unknown
2	DR387820	30	N 17 E	Unknown
3	DR391817	13	E	Unknown
4	DR394819	4	S 38 E	96 FT.
5	DR389813	2	N 55 E	68 FT.

An attempt by enemy personnel was made to lay them in natural approaches of reconnaissance troops or patrols.

CONCLUSION

Cited below are remarks from Lt. Clark:

"The enemy mine field was easy to find due to the following:

a- No pattern
b- Easily observed
c- Improperly placed
d- Did not use terrain for concealment
e- Mines not buried properly.
f- Pins not removed, mines not activated.
g- Trip wires not hooked properly
h- Persons who set them were not trained properly in the use and value of mine fields
i- No fire power on mine fields
j- Some devices missing

"The 8th ROK Engineers have deactivated 2100 mines without a single casualty and these conclusions should be fairly reliable."

It is apparent that the mine field was laid by poorly or untrained enemy troops or guerrillas because of the lack of concealment and haphazard methods of installation.

WILSON R RUTHERFORD JR
1st Lt. CE
Commanding

ANNEX 2

POW Reports on Types and Quantities of Mines Carried

Interrogation reports of seven prisoners of war indicate that small quantities of mines were carried by units charged with land mine emplacement, usually of the same types. The availability of mine detectors to the enemy during this period is noted. This shows the need for skill and deception in emplacement to secure any effect on the enemy. The seven reports are extracted for their mine information below.

Reports on Quantities and Types of Mines Carried by the Enemy

(ATIS #15 rpt 2017)
Mines issued Eng Co, 2nd Bn, 26th Brig
150 TM-41 AT
150 MV-5 pressure igniters
20 POMZ-2 AP mines

(ATIS #16 rpts 2119, 2102)
3rd Engineer Anti-Invasion Bn, (815 Unit)

200 AT mines
60 AP mines

(ATIS rpt 2112)
3rd Indep Antilanding Eng Bn, 1st Co

200 AT mines
93 AP mines

(ATIS #8 rpt 1369)
17 September one officer and twenty men ordered to lay 100 mines between YongDongPo and SangSaDong (982-1646G)
Mines used thus:
30--main road and side road at (989-4156 0)
30--east approach to river bridge at (988-4156A)
unknown number (989-4156)
balance to destroy bridge at (988-4156A)
The work was done in four groups with Russian box-type mines.

(ATIS #9 rpt 1457)
849th Unit Eng Co, 4th Plt, 4th Sqd used three types:
AP fragmentation (grenade type) mounted on wooden stake
AT wooden box (schu type) buried
AT wooden box
Co had three VIM-203 mine detectors

(ATIS #12 rpt 1714)
Enemy Engineer Co
Equipped with:
7 VIM-203 mine detectors
POMZ-2 AP mines

PMD-6 AP mines
Wooden box AT mine
Metal drum AT mine

(ATIS #12, rpt 1718)
Ind Eng Bn (2nd Plt Training Co, 9th Div)
Equipped with:
3 VIM-203 mine detector
50 POMZ-2 type mines
60 TM-41 AT mines

ENEMY MINES

(Based largely on ATIS Research Supplement No. 94, 20 January 1951)

Mine	Charge	Remarks
1. Wooden box AT	Two 5.75-lb blocks	Weather proofed; explosive hermetically sealed; MV-5 or MV-5K fuze; can be detected with SCR-625 within 6 inches.
2. PDM-6 (schu)	TNT .5-lb block	Main charge may be mortar shell or bottle filled with explosive; MUV pull type fuze.
3. NKPA schu	About .5 lb	Similar to PDM-6; MUV with MD-2 detonator, easily detectable; difficult to detect with SCR-625 because of plastic igniter.
4. TM-41	9-lb flako	Circular metal mine; total weight, 12 lbs; MV-5 fuze with MD-2 detonator readily detectable with SCR-625.
5. NKPA AT	5 lbs 12 oz flako	Cast iron; circular; total weight, 30 lbs; MV-5 fuze with MD-2 detonator; easy to detect with SCR-625.
6. NKPA AT	5 lbs	Total weight, 12 lbs; brass igniter; readily detectable.
7. NKPA (Jap) Bangalore torpedo	3.5 lbs	Total weight, 10 lbs.

ANNEX 2

Mine	Charge	Remarks
8. NKPA booby trap	6 oz black powder	Cardboard container; simple fuze igniter; detonating cap and pull wire the only metal.
9. NKPA AP	1.5 lbs, 60 per-cent dynamite	Weight 2 lbs, 4 oz; made by serrating a section of steel pipe; MUV fuze and MD-2 detonator; detectable.
10. TMB-2 AT	unknown	Cylindrical; tar on cardboard case; MV-5 or MV-5K fuze; non-metallic; SCR-625 will not detect.
11. Jap 93	2 lbs picric acid	Cylindrical cast iron; weight, 1.2 kg; non-lethal.
12. Jap 99	2 lbs picric acid	Armor-piercing mine; cylindrical; total weight, 2 lbs, 11 oz; striker type fuze.
13. No. 4 Chin-Ling	6.5 lbs TNT	Armor piercing, cylindrical; weight, 16 lbs
14. No. 8 Chin-Ling	3 lbs picric acid or TNT	Armor piercing, cylindrical; weight, 7 lbs; cast iron; copper igniter.
15. POMZ-2 AP	2.6 oz TNT	Shrapnel mine; cylindrical; weight 3.75 lbs (Shell only); total weight 4.4 lbs; MUV or VPF pull fuze.
16. PMZ-40 AT	8 lbs TNT	Circular steel case; weight, 20 lbs; MV-3 fuze.
17. YAM-5	9 lbs TNT	Wooden case; weight 14 lbs; MUV fuze.
18. NK AT	15.7 lbs TNT plus 1 lb in center	Wooden box mine; difficult to detect with SCR-625.

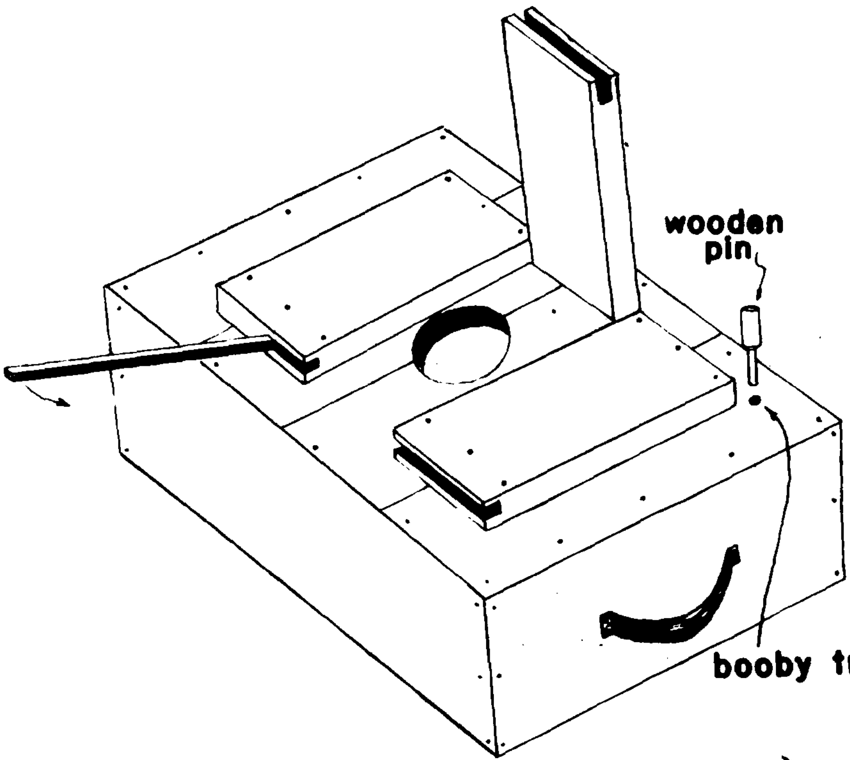
FUZES AND DETONATORS USED BY THE ENEMY*

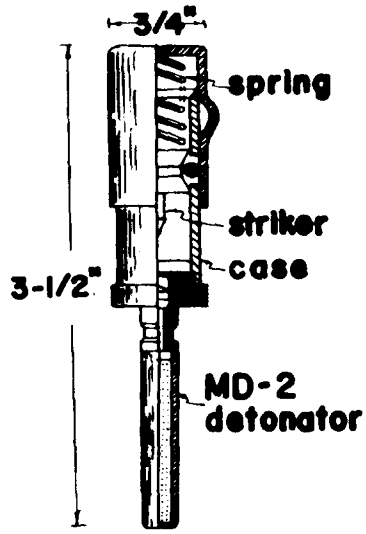
Type	Description
1. Mechanical--electrical	Metallic case with clock work mechanism and battery; weight, .75 lb; destroys bridges, buildings, etcetera, at a time chosen by the expelled defenders.
2. Russian clockwork delay fuze	Weight 1.5 lbs; destroys same as above.
3. Pressure fuze MV-5	Used in certain pressure-operated mines; plastic model is known as MV-5K.
4. Russian MD-2 detonator	Brass detonator; used in almost all known Russian booby traps and land-mine fuzes.
5. Pull fuze, MUV	Metal; operating pull of 1-2 lbs required; the most commonly used type in Soviet mines.

* Information based on EUSAK engineer reports.

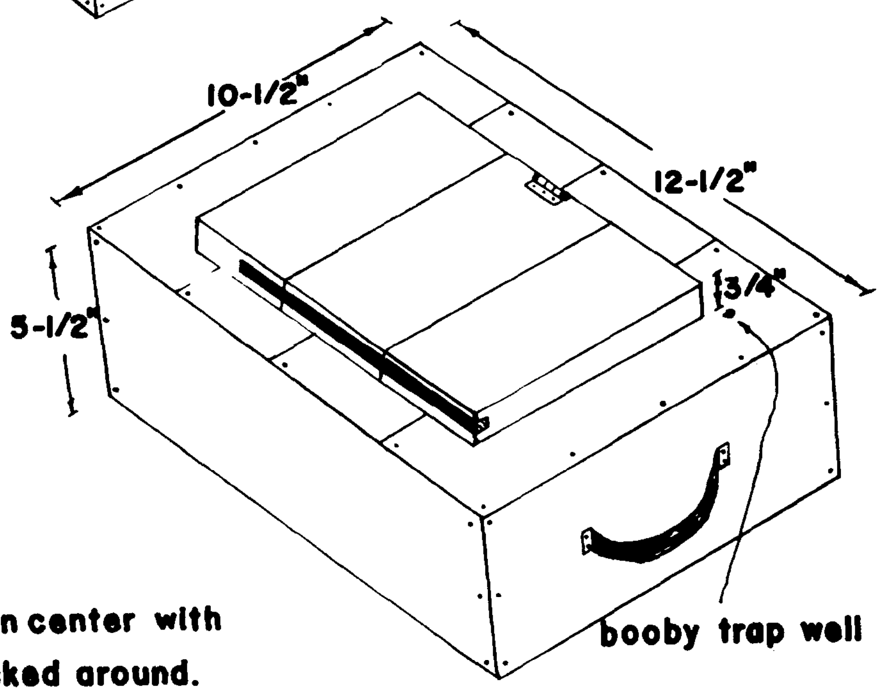
ANNEX 2

ENEMY BOX MINE

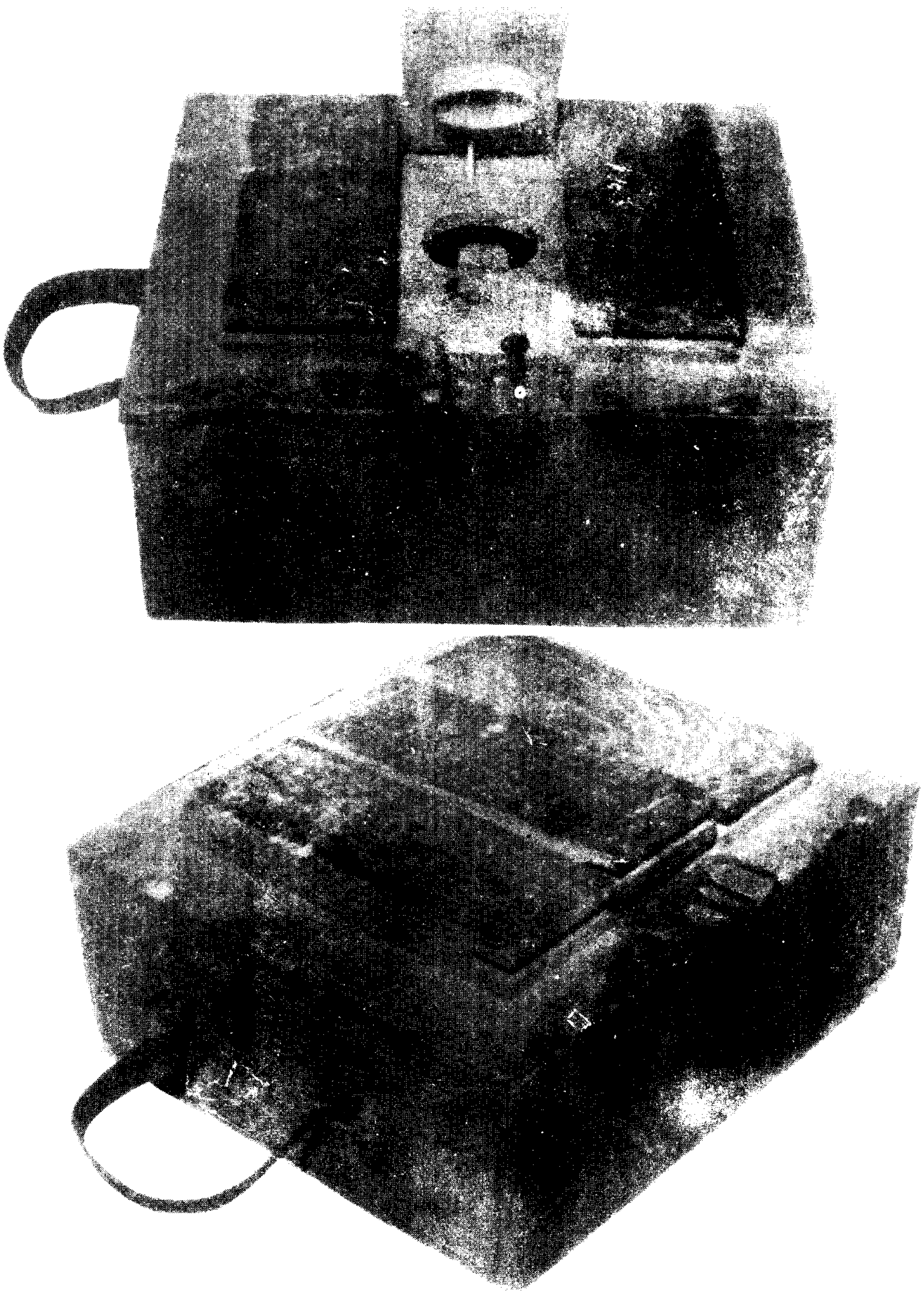




MV-5
PRESSURE IGNITER

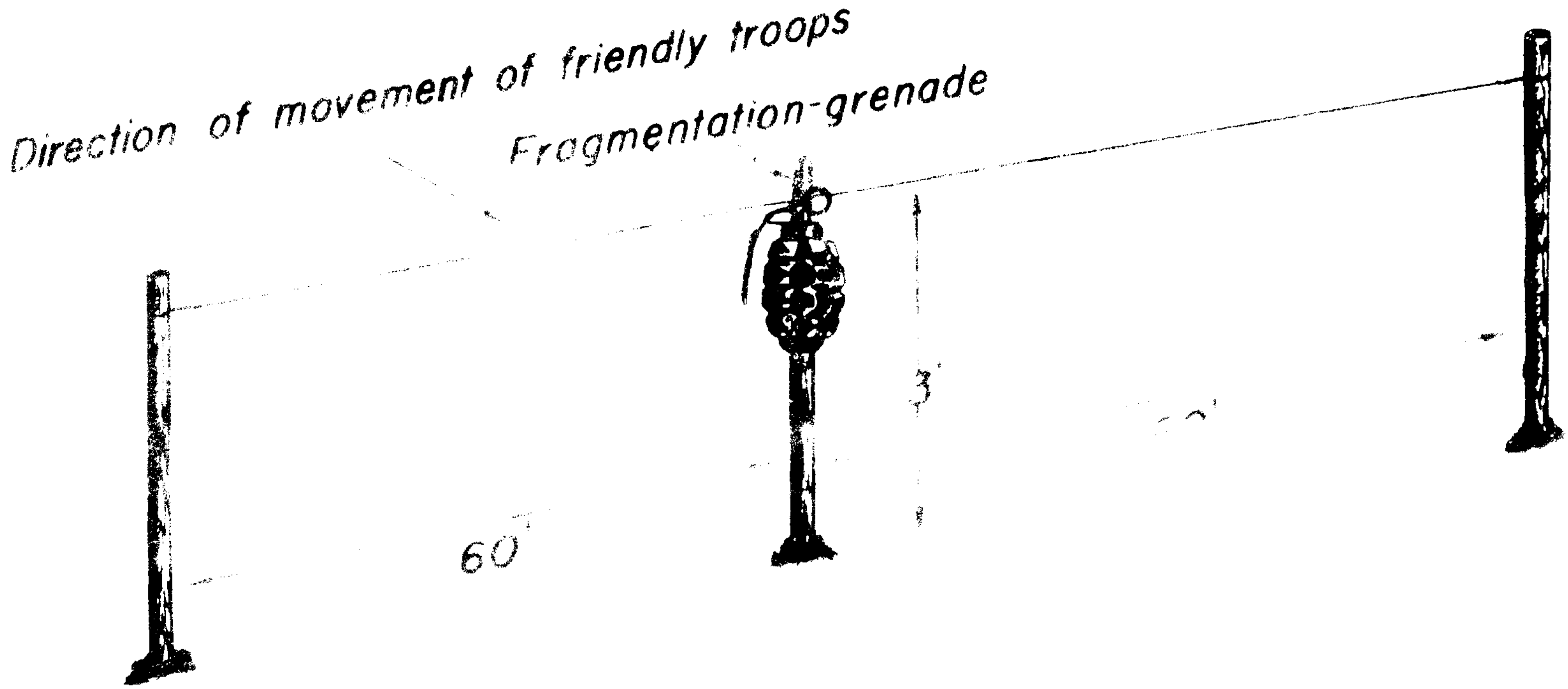


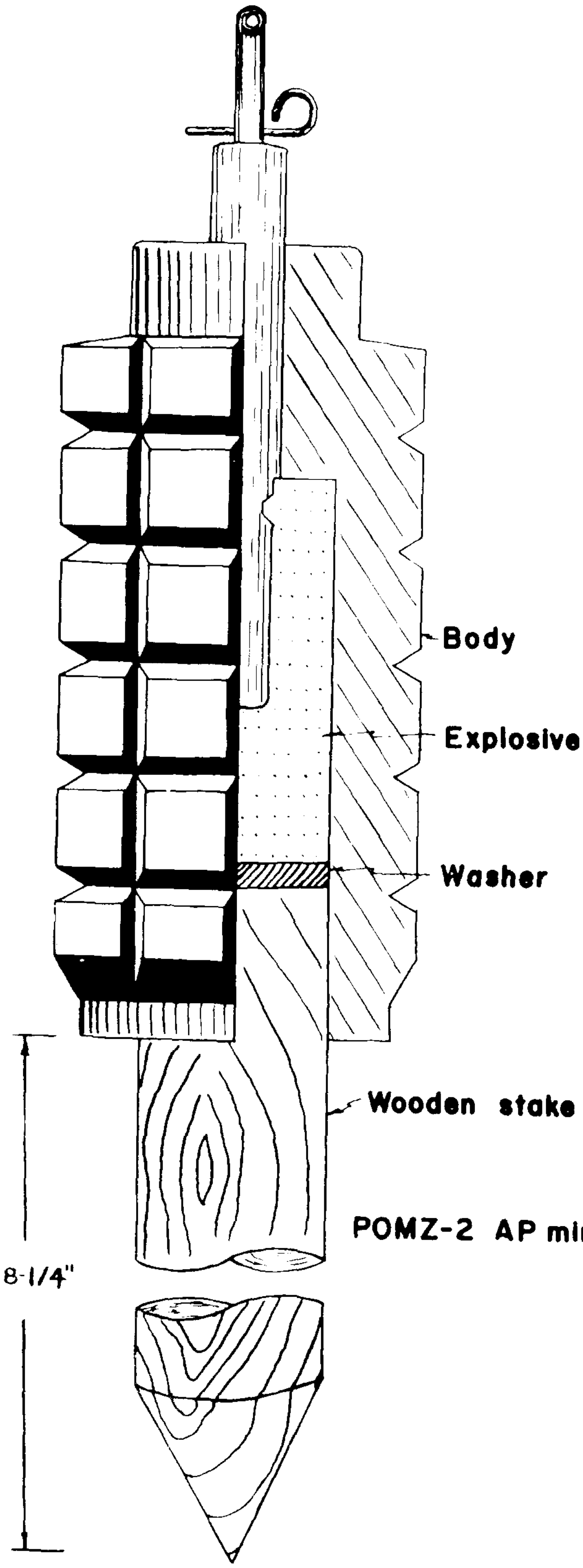
Wt. approx. 15 lbs.
1-1/2 lb. block TNT in center with dynamite or TNT packed around.



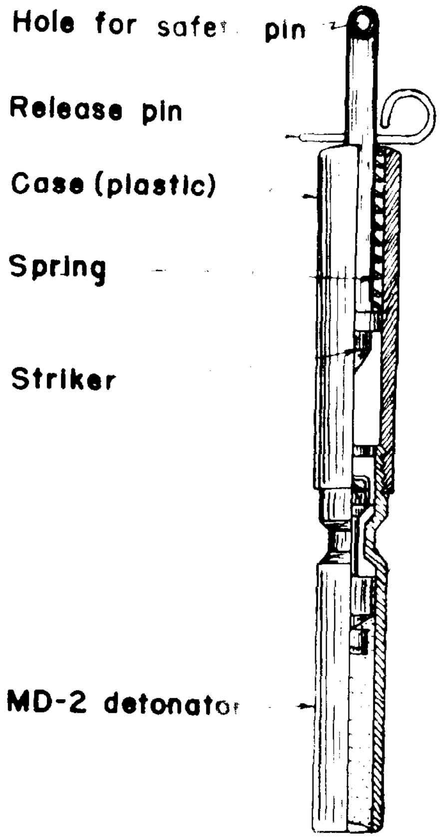
MODIFIED TMD-B MINE
AS USED BY NKPA

NORTH KOREAN IMPROVISED ANTI-PERSONNEL MINE



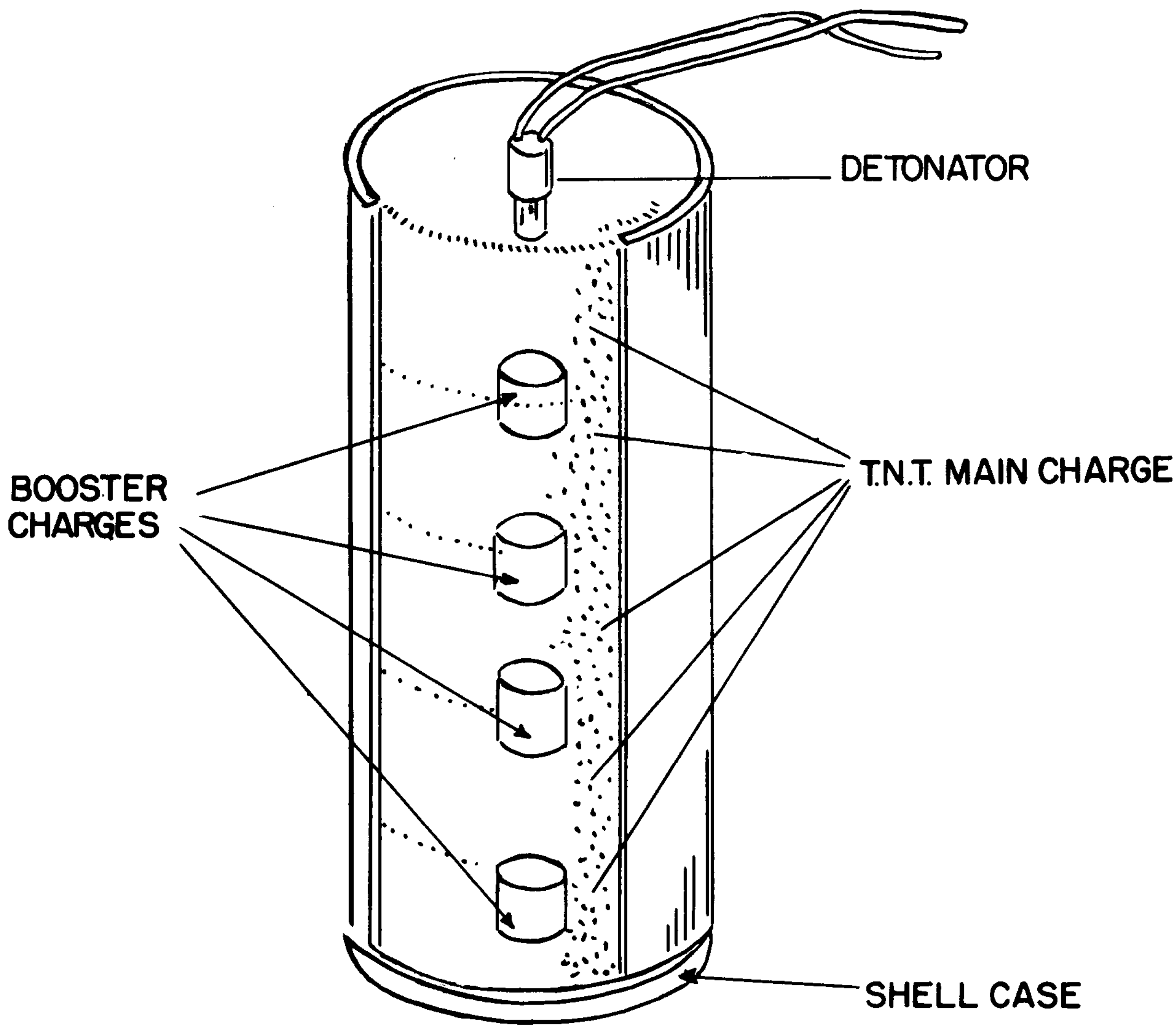


POMZ-2 AP mine



MUV mine ignitor

ANNEX 2



CHINESE IMPROVISED MINE

IMPROVISED MINE UTILIZING ARTILLERY SHELLS AND CARDBOARD CASINGS.

APPENDIX I, ANNEX 3:

VIEWS OF RESPONSIBLE PERSONNEL ON LAND-MINE USE IN KOREA

In the course of collecting material and information on the employment of land mines in Korea, the views and opinions of responsible personnel were obtained. While much of this information is incorporated elsewhere in this report, these opinions are collected here to present the views of others than the writer of this report:

To be effective, a mine field must be covered by fire. US mine-field doctrine was violated by extensive failure of units to report sizes and locations of mine fields.

Self-sterilization should be built into US land mines.

The training of infantry soldiers in land mines has been inadequate.

Weather is a factor to be considered in using land mines.

In a fluid tactical situation such as existed much of the time it is not clear when mines can be used without denying ground to oneself.

The enemy used a limited number of mines and installed them poorly.

The CCF have not been carrying mines but have been improvising them.

One measure of effectiveness is the excellent lift which mines gave to ROK morale.

The first ROKA training on AT mines did not start until 30 June 1950.

It took some time to teach the ROKA the skillful use of mines. They would bury the M7's too deep. The M7 mine singly would not stop a T34/85; two M7's would. Also due to lack of training, the ROKA laid many mines but did not arm them. The NKA recovered many of these.

ANNEX 3

The M6 mine effectively stopped the T34 tank.

It was on the Taegu-Pusan perimeter that the ROK's "really got into the mine business." The South Koreans initially had lost all confidence in mines as a result of using the weak M7. Excellent results were obtained on the perimeter mine fields where about 2,800 AT mines were emplaced.

Two NK platoons were wiped out trying to clear an AP-AT mine field.

Supply was generally good.

From July through September only about 300 ROK troops were available with land-mine training.

The use of mines was important in holding the line during the Taegu defense. The Infantry developed confidence in the engineers and learned to stay and defend obstacles.

The NK were also poorly trained in mine warfare. They missed many chances. Their mines were generally easy to see and they usually made little attempt to conceal mines.

Few pattern fields were found. Mines were emplaced irregularly, scattered.

One NK AP mine useful at night was a crude grenade on a stick projecting 1-3 feet above ground with trip wires. Generally NK mines were no deterrent to the ROK's.

Data on ROK results were hard to get.

South of Uisong--between Uisong and Yongchon--8 NK tanks were damaged by mines laid by the ROK 6th Division. These tanks were personally examined.

A memorandum from the ROK II Corps, 8 September, stated: "The outstanding achievement of the past week is the growth of cooperation between Infantry and Engineers. Infantry commanders have found the worth of Engineers and mine-field effect on the enemy. Prepared fortifications plus digging-in aided immeasureably the II-Corps units holding the line."

AP mines are needed more than AT mines. The enemy gives up lives willingly.

For the defense of Seoul, 1st Cavalry Division asked for 30,000 AP mines; these were not obtainable.

For instance, on 28 January in the Yoju area, a jeep hit a mine killing one man, wounding three, and the jeep was destroyed.

On 1 February it was reported that the ROK had put this field in the previous summer. Many fields laid by the ROK, UN forces, and the US were not reported.

An infantry company can draw mines and not record or make available emplacement data. The division should know each time a company or component draws and uses mines.

Mines were used extensively on the 38th parallel about 30 December 1950. From Kunu-ri to Seoul the pace was too fast, and few mines were used.

The division never stayed on a line long enough to judge the effectiveness of mines. They hesitated to use mines, never knowing when they were going on the defensive or were going to attack.

The infantry is putting in mines, but no records are kept. These fields are a source of worry to other units. No reports were made to Engineer (C) Battalion from unfantry units.

North of Seoul the 3rd Engineer (C) Battalion laid mines in front of the battle line. The 3rd Engineer (C) Bn got only about 25 percent of the AT mines it asked for and about 5 percent of the AP mines it could use.* The ASP could not supply them. On 6 January 1951 the 3rd ECB ordered 35,000 schu mines but got only 1,800.

The 24th Division emplaced an estimated total of 20,000 mines up to January 1951.

Deep fields are not necessarily effective. Mine fields can be swept fast. In one instance 157 AT mines were cleared in 90 minutes.

There was a lack of planning time in a retreat and a shortage of engineer personnel.

There were many instances of civilians and animals being hit by mines.

It takes a day to get mines up from the ASP. North of Seoul, 20 December, the 24th Division spent five days putting in trenches, wire, and fortifications before any mines arrived. Only two days after they got the mines the CCF attacked. The supply-transport situation was not good.

The infantry needs training to ascertain the <u>need</u> for mines. The infantry is not trained in defense.

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* Although not remarked upon by the sources, the 24th Division proved resourceful in making some use of improvised mines.

ANNEX 3

The division engineer should have control and be given an accounting for all mines drawn and used. Mine emplacement should be supervised by engineer personnel.

The CCF does not protect its mines by fire, obtaining only a harassing effect. There is reason to believe that the CCF have shifted some US mine fields.

It has been difficult to conceal mines in the rice paddies and in rainy periods.

The 3rd Engineer (C) Battalion had only two casualties to mines out of 300 casualties.

A choice often must be made between carrying troops or mines. When the 24th Division faced armor it had an inadequate supply of mines.

Extensive mining kills many civilians. Korean civilians a great part of the time have been moving up and down the roads and fields often very close to the actual battle action.

Other factors said by miscellaneous sources to have limited UN use of mines include the fear of killing our own troops, the extreme cold making for great difficulty in emplacement, and the self-denial of ground.

APPENDIX I, ANNEX 4:

PERSONNEL AND TRAINING

One of the difficulties which faced the US forces in the use of land mines in the early part of the Korean campaign was the lack of trained personnel. This problem, together with the over-all shortage of men, and the rapid advances of the enemy in the early stages of the war, seriously affected the US land-mine effort. Information from the Corps of Engineers has indicated that such mine fields as were laid, quite commonly were not properly placed. Roads might be mined, but by-passes and alternative routes would be left free. The areas around approaches to a bridge would not be mined. Furthermore, the extreme speed of envelopment, and of flanking attacks by the enemy, sorely pressed the limited US forces and permitted little time for emplacement of land mines. The situation then was changing so fast that many mine data were lost and locations of many mine fields laid by US forces were not recorded at all.*

The Engineer units in Korea with any training or experience in land mine emplacement are listed in Table I.

TABLE I

ENGINEER UNITS IN KOREA WITH LAND MINE TRAINING**

Unit	Assignment	Approximate Time Arrival
3rd Engr (C) Engr Bn	24th Division	3-4 July
65th Engr (C) Engr Bn	25th Division	7 July
77th (C) Engr Co.	25th Division	7 July
8th Engr (C) Bn	1st Cavalry	14 July
2nd Engr (C) Bn	2nd Division	1 August
72nd Engr (C) Co.	5th RCT	20-25 July
11th Engr (C) Bn	IX Corps	7-8 July
74th Engr (C) Bn	IX Corps	1 Sept
14th Engr (C) Bn	1st Cavalry	14 July

** Source: Lt. Col. John W. Chesley, Jr., EUSAK Engineers.

* Source: Capt. James H. Ball, Jr., EUSAK Engineers.

ANNEX 4

All these units saw much service as infantry except the 11th and 74th Engineer (C) Battalions. The nondivision engineer battalions had been on general duty in Japan and had little training in land-mine installation.

The strength of some selected MOS's in Korea, presumably with some land-mine training, were as shown in Table II.

TABLE II

ACTUAL ENLISTED STRENGTH OF SELECTED MOS's--JULY-NOVEMBER 1950

Title	31 July	31 Aug	30 Sept	31 Oct	30 Nov
0533 Demolition Specialist	63	95	75	79	103
0714 Mine Supply Maint Tech	1	1	2	2	3
0729 Pioneer (Engineer)	53	69	69	69	117
0968 Mine Detector Operator	1	1	1	1	1
1729 Combat Const. Foreman	118	197	248	292	525
3729 Combat Const. Spec.	526	824	967	1,180	1,900

In addition to these, some ordnance personnel such as members of bomb disposal units may be presumed to have had land-mine experience.

The Eighth-Army training was handicapped by lack of space for maneuvers, by occupation duties, and by turn-over of troops. In the general training plan, the first objective was to prepare individuals and units for occupation duties. Instructions were issued for training in use of land mines as part of combat training but implementation met many obstacles. The sections of the training directive and its annexes relating to training in use of land mines are as follows:

(Abstracted from TRAINING DIRECTIVE NO. 4--HQ, Eighth Army, 15 April 1949.)

General Plan

Section I

Para. 2. Objectives.

a. To prepare all individuals and units for occupation duties.

b. To qualify combat unit to accept responsibility and perform primary missions in combat.

* * * * * *

Para 13. Detailed Instructions Applicable to All Units

1. Mines and Booby Traps.

(1) Only inert or practice types will be used in training (see para 3d(4) Cir. 7, GHQ, FEC, 1948).

(2) Units which must be trained in handling mines and booby traps and in clearing extensive mine fields include division engineers, separate engineer combat battalions, platoons and sections of antitank, antitank mine, pioneer and demolition, and ammunition and pioneer units.

(3) Units which must be trained to clear mines and booby traps from small areas include all divisional units and nondivisional units of the combat arms.

(4) Units which function ordinarily in rear areas must be trained to recognize and report mines, booby traps, and suspected mined areas, and understand the procedure for marking mined areas. These units include all types not mentioned in (1) and (2) above.

* * * * * *

(Abstracted from Annex No. 16 to TRAINING DIRECTIVE No. 4--HQ, Eighth Army, 15 April 1949, Training of Engineer Units.)

Para. 3. Technical Training

a. Combat Type Units

(4) Mines and Booby Traps.

Personnel will be instructed in all standard US mines, booby traps, and firing devices. Training will include proper methods and procedures for laying, marking, recording, recognizing, reporting, searching for, clearing or neutralizing all types of mine fields, both enemy and friendly.

* * * * * *

Para. 13. Detailed Instructions Applicable to All Units

cc. (1) Training of Replacements

1) Replacements are being received in this theater who have not completed the full number of weeks of training prescribed by appropriate mobilization training program.

* * * * * *

ANNEX 4

On 3 April 1950, Training Directive No. 5 rescinded No. 4. This directive stated the difficulties created by the rotation plan and gave combat training, rather than training for occupation duties, first priority.

(Abstracted from TRAINING DIRECTIVE NO. 5--3 April 1950-- Rescinds TRAINING DIRECTIVE NO. 4).

Section I

Para 3

(a) The D/A plan for rotation of personnel to and from this theater, and the Eighth Army policy for implementation of that plan result in each unit, regardless of size, returning to the ZI approximately 4 percent of its trained personnel each month. The majority of the replacements for these personnel can be expected to have received no unit training and their individual training period will have been of 8 to 14 weeks duration.

(b) The optimum training cycle commensurate with the training objective of the Eighth Army and with the constant-flow plan, is of 12 months duration. The intermediate objectives specified herein are to be accomplished within the 12-month period subsequent to the effective date of this directive, and again during each similar period thereafter.

4. Policy.

a. Within Eighth Army the training mission has first priority. Duties not authorized in tables of distribution or tables of organization will be reduced to bare essentials and will be rotated among individuals.

5. Objectives

(4) To successfully complete tests on basic individual subjects by every individual. These subjects are listed in MTP-21-1 "Military Training for Newly Enlisted Personnel in the Army."

* * * * * *

Use of Mines in Training:

Circular 7, GHQ, 19 Feb 1949, P. II 3d(4) called for only inert or practice types of mines in training. Live mines could be used in demonstrations by special authorization, as stated in paragraph (4), item d, part 3 of Section II of Circular No. 7, GHQ, FEC, 19 Feb 1948:

"Mines and booby traps. Inert or practice types only will be used in training. High explosive antitank

and antipersonnel mines and booby traps may be used in demonstrations when authorized by regimental or higher commanders."

Circular No. 37, 28 July 1949, also provided that live mines be used in demonstrations only.

Circular No. 37, paragraphs 3c and 3d, state:

"c. The use of live mines and booby traps will be confined to demonstrations only.

"d. Training in live demolitions will be conducted only by units authorized demolition sets in Table of Equipment. This training will be conducted only for personnel required to use demolitions or to act as instructors in their use. Demolitions training for other troops will be confined to demonstrations. The provisions of reference 1b(2) will be adhered to in all cases. These instructions will not be construed to preclude the use of firecrackers, and other small demolitions not likely to cause injury, to simulate battle noises."

Circular No. 57--8 November 1950, relaxed previous regulations somewhat and allowed certain units to use live mines in training. Circular No. 57 in paragraph 4 states:

"The use of live mines and booby traps in training will be confined to demonstrations, except in units authorized by the Commander-in-Chief, Far East, to conduct such training."

Thus, until nearly the end of the period covered in this study, regulations permitted only limited training in handling land mines. Such limited training may well have contributed to our losses from enemy land mines. Infantrymen are reported to have refused to reconnoiter ahead of tanks for mines,* a situation probably arising from their lack of training in land-mine operations.

Again, lack of combat-team training has been reported as permitting use of tanks themselves for mine detectors and exploders.** Probing would have prevented much of the damage done to US tanks. Personnel of the ROK I Corps cleared about 200 mines from a 30-mile stretch of road without the loss of a friendly tank.

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* Comments on Tactical & Technical Problems, 2 Dec 1950, EUSAK-Armor Section.

** Report of Observations of Performance of Ordnance Equipment in Korea, 28 Sept-20 Oct, Col. Joseph M. Colby.

ANNEX 4

Turnover of Troops

The high rate of turnover of troops, mentioned earlier, is shown in the figures for length of service in FEC as of June 1950, given in Table III.

TABLE III

LENGTH OF SERVICE IN FEC FOR OFFICER AND ENLISTED PERSONNEL AS OF JUNE 1950

Personnel	25 Months and Over	19-24 Months	13-18 Months	11-12 Months	1-10 Months	Total
Officers	48	907	3,363	1,399	3,759	9,476
Enlisted	4,482	14,324	23,681	7,340	48,854	98,681

Here it is seen that about 50 percent of the enlisted men had served only 1 to 10 months in FEC and, as was stated in TD No. 5, the majority of replacements were arriving with no unit training and had had individual training for only 8 to 14 weeks. A 12-month training cycle was needed under the constant-flow plan to accomplish the training directive of 3 April 1950.

From the preceding discussion and from statements of officers of Eighth Army* concerned with training, one may say in summary that the training on land mine operations was hampered by lack of facility, high rate of turnover of troops, arrival in FEC of troops largely not trained, lack of unit training, and lack of trained specialists to instruct.

What was lacking for a successful training program, in addition to trained instructors, included training equipment, stability of units, and practical work. Neither officers nor enlisted men were adequately trained in land-mine work, their training generally consisting of a brief course in a crowded OCS or RTC schedule, perhaps augmented by about 3 hours in class at Ft. Benning. Such blackboard work was not usually, however, supplemented by practical experience. Lt. Col. Vincent P. Carlson of the Engineer School has mentioned lack of facilities for practical training as a great handcap in the training program.

ROK Army Personnel and Training**

The ROK Army mine training was initially handicapped by having only three American advisors on the project. With the

* Views obtained from Eighth Army officers concerned with training: Lt. Col. Thomas R. Kelly, Lt. Col. Vincent P. Carlson, Lt. Col. Frederick E. Johnson and Major Robert J. Demers.

** Major Richard Crawford--KMAG.

arrival, on 29 June, of 90 M7 mines and, on 30 June, of 500 M6 mines by airlift, the first AT mine training started. It took considerable time to teach the ROKA skill in use of mines. Among other difficulties, they would bury the M7's too deep. At first the ROKA had no confidence in mines; many of those laid were not armed. It was estimated that of the whole ROKA in July and August, only 300 men had any land-mine training. The ROKA school had started 1 September but it was about 15 October before some mine training was included in the school. Despite the lack of training, the ROKA developed confidence in mines and emplaced mines with great success.

APPENDIX I, ANNEX 5:

SUPPLY AND EXPENDITURE OF LAND MINES IN FEC

SUPPLY

The supply of land mines in FEC was generally adequate. The relatively weak supply of antipersonnel mines was supplemented by production of schu mines in Japan. This production is discussed later on.

Basic Load and Authorized Theater Levels

Under Eighth Army Circular No. 4, 18 January 1950, the authorized basic load of land mines was:

AT mines--per regiment		150*
	per lettered engineer combat company	300*

* 50 percent to be M6 and 50 percent to be M7 mines

AP mines--per regiment		200*
	per lettered engineer combat company	400*

* 50 percent to be M2, and 50 percent to be M3

The basic load is geared to an organization's organic transport. That is, the normal usage of assigned transport provides for this quantity of land mines in conjunction with all other TO&E to be carried. If a bigger load is carried, it is done so at the expense of carrying other equipment up to authorized allowances. Units going to Korea carried at least their normal basic load of land mines.

Authorized FEC Levels

The following are the authorized FEC levels for US mines:

M2	M3	M6	M7
8,250	16,500	165,000	82,500

At the start of the war almost 49,000 AP mines and almost 64,000 AT mines were available in the FEC. The supply of AP mines

was low, falling below 16,000 in September and only some 19,021 were available in the critical period 1-10 December. The highest number for the period was 63,789 during 1-10 November. The supply of AT mines was more favorable, showing an upward trend from the 63,928 available at the start of the period (see Table I).

Transport

Transport difficulties is one problem not to be overlooked. The railroad transport system was not in a favorable condition at the start of the war. The Japanese had failed to maintain the railroads during World War II, and poor maintenance was provided in the postwar period. Rolling stock, facilities, and rights-of-way were not in good condition. In addition, many of the skilled workers and the management had been Japanese. In effect, the US forces had to depend upon Korean operators, and they were just being trained in railroad operations. The Port Transportation Department had no Rail Transport Battalion in Korea from 1 July to 15 August--the most critical period. Since the availability of highways to move ammunition and supplies was limited, a burden was placed on this inadequate railroad system. The movement of land mines to ASP's and to the troops was therefore necessarily limited by rail and road conditions. Requests for mines, as a result, often were not fully satisfied.

EUSAK ASP's

Table II shows the ASP stock levels for period 10 September-18 December 1950. The low level of AP mines is particularly noticeable. While the stocks of AT mines were higher, they dwindled in the critical November-December period without any sizeable replenishments from EUSAK depots (see Table III). The stocks of AP mines were quite constant through October but after 2 November were drawn down and never resupplied in any appreciable quantity for the remainder of the period. For the critical phase from 26 November to the end of period the ASP stocks of AT mines were never above ten percent of the available depot stocks. After 7 December the ASP stock of AP mines was a large part of the total stocks in Korea.

EUSAK Depots

Table III shows the on-hand stocks in EUSAK depots for 10 September-18 December 1950. Sizeable stocks of AT mines were on hand for the entire period. The low stocks of AP mines for the entire period are, however, evident.

X Corps Depots

Table IV shows the X Corps depot supply for the period 1 November-14 December 1950. The stocks of AP mines were negligible for most of the period, rising to less than 4,000 in the last week of the period. The AT mine stocks remained at a level of about

ANNEX 5

TABLE I

LAND MINES AVAILABLE IN FEC
(Data collected from Theater Ammunition Reports)

No. Available

Date	M2	M3	Total
26 June	19,200	29,432	48,632
11 Sept	11,994	3,647	15,641
21 Sept	10,069	5,828	15,897
1 Oct	17,741	3,204	20,945
11 Oct	24,224	9,717	33,941
1 Nov	18,984	44,805	63,789
11 Nov	20,655	10,663	31,318
21 Nov	14,677	14,646	29,323
1 Dec	14,572	4,449	19,021
11 Dec	15,731	33,965	49,696
	M6	**M7**	**Total**
26 June	45,057	18,871	63,928
11 Sept	38,582	53,562	92,144
21 Sept	55,983	122,538	178,521
1 Oct	76,038	71,250	147,288
11 Oct	81,246	79,290	160,536
1 Nov	115,614	79,794	195,408
11 Nov	195,852	94,492	290,344
21 Nov	141,000	92,958	233,958
1 Dec	142,329	93,191	235,520
11 Dec	448,024	151,936	599,960

TABLE II

EUSAK ASP STOCK LEVELS

Date	M2	M3	M6	M7
9-10 Sept	760	1,281	13,877	14,008
12 Sept	870	1,999	12,475	9,962
22 Sep	7,527	3,308	12,289	17,847
23 Sept	7,367	3,347	12,719	18,735
24 Sept	8,251	1,998	14,019	17,791
28 Sept	15,260	2,559	16,250	25,950
30 Sept	15,380	2,571	17,057	25,950
1 Oct	16,130	2,667	17,214	20,527
2 Oct	9,411	8,900	17,214	20,548
3 Oct	3,920	834	4,495	11,129
4 Oct	9,947	8,916	17,216	26,107
6-11 Oct	10,797	1,554	12,721	21,445
12-14 Oct	11,018	1,554	12,721	21,741
15-16 Oct	10,998	1,524	12,721	21,677
17-18 Oct	10,778	1,524	12,721	21,381

TABLE II (Continued)

Date	M2	M3	M6	M7
20-23 Oct	10,998	1,524	12,721	21,677
26-28 Oct	10,998	1,578	12,800	21,677
29 Oct	10,998	1,524	12,721	21,677
31 Oct	11,008	1,554	12,802	21,837
2 Nov	10,998	1,524	12,721	21,677
3 Nov	230	296	6,982	16,561
5 Nov	230	685	7,352	18,305
7 Nov	230	529	7,352	17,105
8 Nov	673	10	6,982	17,305
9 Nov	200	1,523	8,069	17,731
11 Nov	---	528	4,497	17,731
12 Nov	---	542	4,497	17,731
13 Nov	---	1,572	5,373	17,731
14 Nov	498	1,572	5,885	17,731
15 Nov	1,163	1,098	6,520	17,731
16 Nov	1,163	1,098	7,207	17,731
17 Nov	1,173	1,040	7,207	17,731
18 Nov	3,093	1,040	7,837	20,107
19-21 Nov	3,189	1,106	7,837	20,107
22 Nov	3,189	1,106	4,674	3,546
23 Nov	3,189	1,106	8,707	3,546
24 Nov	3,189	2,086	8,707	7,521
25 Nov	2,959	1,882	8,707	7,521
26 Nov	3,269	1,984	8,207	7,521
27 Nov	1,999	1,442	7,217	7,521
28 Nov	900	980	5,163	3,975
30 Nov	2,070	2,522	5,582	3,975
2 Dec	2,070	1,836	7,722	---
7-8 Dec	1,460	1,086	821	---
10 Dec	3,460	1,886	1,821	---
11 Dec	3,460	1,086	1,821	---
14 Dec	---	2,000	1,000	---
16 Dec	950	1,020	1,531	---
17 Dec	110	1,020	4,798	6,000
18 Dec	110	1,020	9,369	6,800

TABLE III

EUSAK DEPOT STOCK LEVELS

Date	M2	M3	M6	M7
9 Sept	12,274	642	13,930	46,231
12 Sept	8,734	140	11,535	44,727
21 Sept	1,609	588	9,609	25,207
22 Sept	1,609	588	25,212	30,239
24 Sept	1,609	588	27,686	31,743
27 Sept	1,609	588	28,845	31,743
30 Sept	1,609	588	30,593	31,743
1-2-3- Oct	1,609	588	30,593	31,743

ANNEX 5

TABLE III (Continued)

Date	M2	M3	M6	M7
4 Oct	1,659	594	32,110	31,719
5 Oct	256	7	37,113	27,230
6 Oct	256	7	37,113	30,430
7 Oct	581	7	37,448	30,902
8-9 Oct	1,214	1,087	37,508	31,438
10 Oct	1,214	1,087	39,507	32,438
11 Oct	15,129	1,087	45,645	49,163
12 Oct	15,069	943	43,379	46,963
13 Oct	14,959	919	44,355	46,451
14 Oct	16,390	1,417	44,345	49,667
15 Oct	17,030	4,781	49,302	51,355
16 Oct	17,286	1,781	49,006	51,355
17 Oct	7,595	3,577	50,950	52,950
18 Oct	7,721	4,021	51,741	58,022
20 Oct	7,821	4,021	51,741	58,022
23 Oct	7,821	4,021	56,703	68,304
26 Oct	7,821	6,571	58,251	71,816
27 Oct	7,821	9,139	58,410	71,816
28 Oct	7,821	9,139	63,564	71,816
29 Oct	7,821	9,139	64,921	72,352
31 Oct	7,821	9,139	64,921	72,352
2 Nov	3,540	7,879	45,305	72,352
3 Nov	5,420	8,013	44,505	69,752
4 Nov	5,780	8,079	45,305	72,352
5 Nov	3,050	8,751	13,169	64,752
7 Nov	3,050	8,751	14,169	64,752
8 Nov	7,410	9,079	22,087	64,752
9 Nov	6,910	8,591	18,087	64,752
11 Nov	6,910	8,591	22,556	64,752
12 Nov	6,910	8,591	34,047	65,152
13 Nov	6,830	8,087	36,759	65,152
14 Nov	5,430	8,087	35,409	65,152
15 Nov	5,430	8,087	51,919	64,752
16 Nov	5,430	8,087	63,928	65,152
17 Nov	5,430	8,087	64,928	65,152
18 Nov	8,470	8,062	64,928	65,148
19 Nov	8,470	8,062	66,514	65,148
20 Nov	8,470	8,062	75,916	65,148
21 Nov	10,870	9,166	79,559	65,148
22 Nov	10,870	9,166	85,931	65,148
23 Nov	10,860	9,352	87,981	65,140
24 Nov	10,860	8,849	87,981	65,140
25 Nov	10,685	8,848	91,473	65,140
26-27 Nov	10,685	8,848	91,518	65,140
28 Nov	8,325	4,346	99,162	64,636
30 Nov	7,315	3,344	99,348	76,716
2 Dec	7,315	3,344	95,408	76,716
4 Dec	7,215	3,344	95,408	76,716
6 Dec	3,715	1,340	94,408	76,716

TABLE III (Continued)

Date	M2	M3	M6	M7
8 Dec	2,385	917	92,908	76,004
9 Dec	985	941	91,908	76,004
10 Dec	985	941	86,282	67,004
11 Dec	1,105	2,297	80,282	67,012
14 Dec	1,105	2,297	79,786	67,012
15 Dec	1,105	2,801	79,586	66,876
16 Dec	1,005	2,705	78,454	42,360
18 Dec	1,335	10,265	80,168	36,360

TABLE IV

X CORPS DEPOT STOCK LEVELS

Date	M2	M3	M6	M7
1-2 Nov	130	--	3,047	428
4 Nov	130	--	3,393	428
6 Nov	30	--	3,676	428
7 Nov	30	--	3,676	524
8 Nov	30	--	3,676	1,180
10 Nov	30	244	3,676	1,180
11-13 Nov	30	--	3,676	1,180
14 Nov	30	--	1,674	--
15 Nov	110	24	1,852	4,640
16 Nov	60	24	1,852	4,640
17-18 Nov	60	36	2,450	4,664
19-20 Nov	10	36	2,450	4,664
21 Nov	10	36	2,346	4,304
22-23 Nov	10	36	3,450	4,200
25 Nov	57	30	2,977	4,112
30 Nov	--	54	3,542	3,102
1 Dec	--	54	1,232	3,102
2 Dec	--	108	5,609	5,062
3 Dec	--	6	5,649	5,966
5 Dec	--	--	5,572	5,781
6 Dec	--	--	8,098	5,104
7 Dec	--	--	7,998	4,904
8 Dec	1,220	2,630	9,766	12,191
9 Dec	1,100	2,618	14,516	17,335
10 Dec	1,100	2,522	16,724	17,551
12 Dec	1,080	1,718	16,719	12,647
14 Dec	1,110	1,736	18,786	26,047

TABLE V

X CORPS ASP STOCK LEVELS

Date	M2	M3	M6	M7
23 Nov	130	179	6,009	2,024
24-27 Nov	348	90	5,728	2,040
28 Nov	348	90	5,685	2,200

ANNEX 5

TABLE V (Continued)

Date	M2	M3	M6	M7
29 Nov	298	90	5,731	2,256
30 Nov	298	90	5,725	2,256
1-3 Dec	298	--	5,851	2,256
4-5 Dec	298	--	5,751	2,256
6-7 Dec	ASP's closed			

TABLE VI

LAND MINES EXPENDED IN
PERIOD 26 JUNE-20 DECEMBER 1950
(Data collected from Theater Ammunition Reports)

Period	M2	M3	M6	M7
26 June-10 Sept	7,302	27,147	34,693	36,261
11-20 Sept	1,000	3,651	5,389	6,876
21-30 Sept	1,436	2,624	12,841	7,210
1-10 Oct	260	--	--	6,103
11-20 Oct*	810	7,070	6,515	8,386
1-10 Nov	230	1,524	615	734
11-20 Nov	9,084	2,638	11,962	7,741
21-30 Nov	1,840	10,197	3,058	4,090
1-10 Dec	5,484	2,926	5,628	8,947
11-20 Dec	3,980	3,977	17,650	1,993
	31,426	61,754	98,351	88,341

* The last period in October is missing above. The monthly breakdown received from Lt Col Judson, however, includes that period for AT mines. His figures are given in Table VIA.

TABLE VIA

Period	M6	M7
26 June-10 Sept	34,693	36,261
Balance Sept	18,730	14,086
Oct	8,236	16,632
Nov	15,635	12,565
Dec (to 20th)	23,278	10,940
Total expenditures	100,572	90,484
On hand 8th Army 20 Dec 1950	84,414	87,199
On hand 10 Corps 20 Dec 1950	21,141	28,039
Total land mines in Korea	206,127	205,722
Percent of Total expended*	48	44

* The term expended is limited to mean issue by Ordnance to troops.

APPENDIX I

TABLE VII

MINES ABANDONED AND DESTROYED IN ASP'S
(Period 28 November-15 December 1950)

	M2	M3	M6	M7
8th Army	1,809	918	1,644	3,546
X Corps	50	--	729	127
Total	1,859	918	2,373	3,673

TABLE VIII

LAND MINES EXPENDED

Period	M2	M3	M6	M7	Schu Mines	Total
7-16 Nov.	9,084	2,638	11,962	7,741	--	31,425
17-25 Nov.	1,840	488	3,058	4,090	25	9,501
26 Nov.-4 Dec.	5,484	2,926	5,628	8,947	--	22,985
5-13 Dec.	3,980	3,977	17,650	1,993	--	27,600
14-22 Dec.	2,450	5,004	4,848	4,994	6,185	23,481

3,500 to 6,500 in November and rose steadily from about 4,000 to approximately 44,000 in the first two weeks of December.

X Corps ASP's

Table V shows the ASP supplies from 23 November through 7 December when the ASP's closed. The AP stocks were negligible and the AT stocks remained at about 8,000. The stocks were not drawn on to any extent during this critical period.

EXPENDITURES

Table VI shows the expenditures of land mines for ten day periods from 26 June through 20 December. The period 26 June-10 September is not broken down because of the lack of detailed data for that period. As would be expected, the heaviest periods were those of the retreat phases of the war. The data furnished for this report by Japan Logistical Command indicates that less than half the total AT mines in Korea were expended during this period.

Mines Abandoned and Destroyed

Table VII shows the numbers of mines reported abandoned and destroyed during the retreat phase from 28 November through 15 December. This indicates the pace of the tactical situation as a factor in the use of mines as mentioned elsewhere in this report.

The breakdown in Table VIII shows the expenditures during the retreat phase in November and December and the periods preceding this. The expenditures 17-26 November were light (9,461) during the US advance. During 25 November-4 December, a retreat phase, the expenditures more than doubled. From then until 13 December, expenditures doubled again for all types collectively.

The Schu Mine

The supply of US AP land mines in FEC was increased by the local production of schu mines in Japan. This production was accomplished with speed and economy, and the information about this project is included not only as an important part of the supply picture but also as an example of what can be achieved in short order in a theater of operation.

The dreaded schu mine was encountered by Allied combat troops throughout the Mediterranean and European campaigns. It was one of the most widely used types of antipersonnel mines in World War II. It was first used in the Russo-Finnish war by both the Soviets and the Finns. Easy and cheap to manufacture, simple to lay yet difficult to detect, effective against foot troops, it was adopted as standard in the German and Italian armies. It was

employed in the Greek fighting and is still standard equipment in the Soviet Army.. The term "schu mine" was derived from the German abbreviation for the word "schutzenmine" literally translated as "rifleman's mine."

This mine can be laid on top of a larger explosive charge. The Soviets have used it with a small mortar shell or glass bottle filled with explosive as the main charge instead of the usual one-half pound block of TNT.

On 26 July 1950 EUSAK ordered 1,000 schu mines manufactured. On 30 July an additional 3,000 were ordered for which component parts were available. Additional parts were requisitioned from the ZI for 20,000 more. On 3 August 300 were shipped to Korea. On 7 August the EUSAK order was increased to 40,000 mines and on 12 August the order was changed to 200,000 mines to be made at the rate of 10,000 a day. Loading was done at Tana storage depot, a sub-depot of Ikego. About two weeks was the time from the initial procurement request to the first deliveries.

Seven contracts at varying prices were let to procure parts.

	Quantity		Unit Costs		Dollar Cost	Average Unit Cost
Devices	45,000	@	.76	(die cast)	$ 34,200.	
	10,000	@	3.20	(machined)	32,000.	
	10,000	@	2.00		20,000.	
	35,000	@	.89		31,150.	
	100,000	@	.63		63,000.	
	200,000				$180,350.	$ .90
Cases	30,000	@	.18		5,400.	
	130,000	@	.55		71,500.	
	40,000	@	.14	(transport depot shop labor)	5,600.	
	200,000				$82,500.	.41
						$1.31

All contracts were completed. The US furnished the TNT, blast caps, and primers. Japanese firms completed the contracts.

An estimate of the effort at the Army Transport Depot shows that 40 people on an eight-hour day were able to turn out 1,500 schu boxes daily.

The 200,000 mine cost was:

Devices (average cost)	$ .90
Case (average cost)	.41
TNT	.10
Assembly	.02
	$1.43

ANNEX 5

The estimates of costs received from Ikego Ammunition Depot on 11 January 1951 indicated the following unit costs:

Devices	$ .47
Case	.25
TNT	.10
Assembly	.02
Unit Cost	$ .84

The detail on the assembly operation consisting of an eleven-man crew shows:

Man No. 1. Open assembly-box packing crates, remove assembly box, inspect and check to see that all components are present, place assembly box on work table.
Time required: 10 seconds.

Man No. 2. Open firing-device packing crates, remove firing devices, inspect and place on work table.
Time required: 5 seconds.

Man No. 3. and 4. Insert TNT block and firing device into assembly box, in the READY FOR USE POSITION, pass to man no. 5 and no. 6.
Time required: 10 seconds.

Man No. 5. and 6. Inspect and check assembly to assure that all connections are sufficient for the desired function, then change position of firing device, TNT block, and wooden block separator to the STORED POSITION, close lid of assembly box, pass to man no. 7 and no. 8.
Time required: 9 seconds.

Man No. 7. and 8. Stencil prearranged lot number on top of assembly box, place rubber bands (2) around box, pass to man no. 9.
Time required: 6 seconds.

Man No. 9. Replace loaded assembly box (schu mine) into original packing crate, 25 mines per crate, stencil crate, pass to man no. 10.
Time required: 2 seconds.

Man No. 10. Band crate and place on completed stack.
Time required: 1 minute, 45 seconds.

Man No. 11. Duties not specified.

TOTAL MINE FIELDS REPORTED TO EIGHTH-ARMY ENGINEERS
(27 June-30 November)

Field No.	AP			AT			
	No.	Type		No.	Type		Date
1	--	--	--	10	M6	--	13 Aug
2	--	--	--	14	M6	--	13 Aug
3	35	M3	--	--	--	--	23 Aug
4	8	M2A3	--	10	M6	--	23 Aug
5	91	M2A1	--	--	--	--	20 Aug
6	36	M3	--	--	--	--	22 Aug
7	11	M2	--	--	--	--	24 Aug
8	17	M2	--	--	--	--	24 Aug
9	18	M2	--	--	--	--	21 Aug
10	18	M2	--	--	--	--	23 Aug
11	18	M2	--	--	--	--	25 Aug
12	5	M3	--	--	--	--	17 Aug
13	4	M3	--	--	--	--	17 Aug
14	6	M3	--	--	--	--	17 Aug
15	--	--	--	20	M6	--	16 Aug
16	115	M2(33), M3(82)		--	--	--	24 Aug
17	--	--	--	225	M6	--	26 Aug
18	24	M2	--	--	--	--	26 Aug
19	21	M2	--	--	--	--	26 Aug
20	12	M2	--	--	--	--	24 Aug
21	16	M2	--	--	--	--	25 Aug
22	8	M2	--	--	--	--	25 Aug
23	9	M2	--	--	--	--	26 Aug
24	15	M2	--	--	--	--	26 Aug
25	9	M2	--	--	--	--	27 Aug
26	2	M2	--	--	--	--	27 Aug
27	--	--	--	291	M6	--	18 Aug
28	9	M3	--	--	--	--	17 Aug
29	--	--	--	74	M6	--	17 Aug
30	--	--	--	65	M6	--	17 Aug
31	39	M2(32), M3(7)		--	--	--	18 Aug
32	40	M2	--	--	--	--	17 Aug
33	44	M2	--	--	--	--	18 Aug
34	17	M3	--	--	--	--	19 Aug
35	16	M2(4), M3(12)		--	--	--	19 Aug
36	6	M3	--	--	--	--	19 Aug
37	9	M2	--	--	--	--	20 Aug
38	10	M2	--	--	--	--	20 Aug
39	5	M2(4), M3(1)		--	--	--	20 Aug
40	9	M2	--	--	--	--	19 Aug
41	--	Trip flares		--	--	--	19 Aug
42	10	M2	--	--	--	--	18 Aug
43	24	M2	--	--	--	--	18 Aug
44	24	M2	--	--	--	--	19 Aug

ANNEX 5

Field No.	AP No.	AP Type		AT No.	AT Type		Date
45	--	--	--	24	M6	--	15 Aug
46	--	--	--	21	M6	--	15 Aug
47	--	--	--	70	M6	--	19 Aug
48	--	--	--	177	M6	--	21 Aug
49	42	M2	--	--	--	--	21 Aug
50	9	M2	--	--	--	--	21 Aug
51	--	--	--	76	M6(42), M7(34)		16 Aug
52	9	M2	--	--	--	--	19 Aug
53	28	M3	--	265	M6	--	30 Aug
54	36	M3	--	--	--	--	21 Aug
55	--	--	--	12	M6	--	13 Aug
56	--	--	--	49	M6	--	15 Aug
57	--	--	--	6	M6	--	15 Aug
58	26	M2A1	--	19	M6	--	4 Aug
59	--	--	--	25	M6	--	19 Aug
60	--	--	--	17	M6	--	3 Aug
61	--	--	--	11	M6	--	5 Aug
62	12	M3	--	99	M6	--	27 Aug
63	13	M3	--	--	--	--	28 Aug
64	6	M2	--	--	--	--	26 Aug
65	9	M2	--	--	--	--	27 Aug
66	15	M3	--	--	--	--	28 Aug
67	6	M2	--	--	--	--	27 Aug
68	4	M2	--	--	--	--	27 Aug
69	4	M2	--	--	--	--	26 Aug
70	6	M2	--	--	--	--	26 Aug
71	6	M2	--	--	--	--	26 Aug
72	10	M3	--	Destroyed	--	--	26 Aug
73	10	M2	--	Destroyed	--	--	26 Aug
74	9	M2	--	--	--	--	26 Aug
75	18	M3	--	--	--	--	29 Aug
76	30	M2	--	--	--	--	28 Aug
77	--	--	--	--	--	--	
78	--	--	--	6	M6	--	15 Aug
79	--	--	--	6	M6	--	15 Aug
80	12	M2(5), M3(7)		--	--	--	30 Aug
81	27	M3	--	--	--	--	9 Aug
82	9	M2	--	--	--	--	30 Aug
83	32	M2(12), M3(20)		--	--	--	31 Aug
84	30	M2	--	--	--	--	30 Aug
85	10	M3	--	--	--	--	1 Sept
86	7	M3	--	--	--	--	1 Sept
87	9	M2	--	--	--	--	25 Aug
88	30	M3	--	--	--	--	3 Sept
89	6	M3	--	--	--	--	1 Sept
90	28	M3	--	--	--	--	4 Sept
91	9	M2	--	--	--	--	25 Aug
92	10	M2	--	--	--	--	28 Aug

Field No.	AP No.	AP Type		AT No.	AT Type		Date
93	4	M2	--	--	--	--	27 Aug
94	2	M2	--	--	--	--	27 Aug
95	5	M2	--	--	--	--	27 Aug
96	21	M2	--	--	--	--	9 Sept
97	33	M2	--	--	--	--	6 Sept
98	13	M2A2	--	--	--	--	10 Sept
99	4	M3	--	--	--	--	29 Aug
100	4	M3	--	--	--	--	29 Aug
101	7	M3	--	--	--	--	29 Aug
102	8	M3	--	--	--	--	5 Sept
103	66	M3	--	--	--	--	8 Sept
104	18	M3	--	--	--	--	8 Sept
105	40	M2(10), M3(30)		--	--	--	8 Sept
106	70	M2	--	--	--	--	14 Sept
107	134	M2(73), M3(61)		--	--	--	13 Sept
108	143	M2	--	--	--	--	14 Sept
109	67	M3	--	--	--	--	15 Sept
110	6	M3	--	--	--	--	17 Sept
111	10	M3	--	--	--	--	17 Sept
112	6	M3	--	--	--	--	17 Sept
113	5	M2(4), M3(1)		--	--	--	20 Aug
114	--	--	--	177	M6	--	21 Aug
115	--	--	--	11	M6	--	5 Aug
116	10	M2	--	--	--	--	20 Aug
117	30	M3	--	--	--	--	3 Sept
118	--	--	--	21	M6	--	15 Aug
119	28	M3	--	--	--	--	4 Sept
120	--	--	--	74	M6	--	17 Aug
121	12	M2	--	--	--	--	24 Aug
122	9	M2	--	--	--	--	27 Aug
123	6	M2	--	--	--	--	26 Aug
124	6	M3	--	--	--	--	19 Aug
125	--	--	--	17	M6	--	3 Aug
126	2	M2	--	--	--	--	27 Aug
127	5	M2	--	--	--	--	27 Aug
128	12	M3	--	99	M6	--	27 Aug
129	--	--	--	225	M6	--	26 Aug
130	--	--	--	--	--	--	
131	8	M2A3	--	10	M6	--	23 Aug
132	35	M3	--	--	--	--	23 Aug
133	21	M2	--	--	--	--	9 Sept
134	--	--	--	12	M6	--	13 Aug
135	--	--	--	14	M6	--	13 Aug
136	8	M2A3	--	10	M6	--	--
137	42	M2A1	--	--	--	--	4 Aug
138	2	M2	--	--	--	--	27 Aug
139	155	M3	--	--	--	--	4 Aug
140	10	M2A1(5,, M3(5)		--	--	--	4 Aug

ANNEX 5

Field No.	AP		AT			
	No.	Type	No.	Type		Date
141	15	M2A1(8), M3(7)	--	--	--	4 Aug
142	--	-- --	12	M6	--	2 Aug
143	--	(see field 27)	--	--	--	
144	--	(see field 27)	--	--	--	
145	15	M3 --	--	--	--	6 Aug
146	15	M3 --	--	--	--	7 Aug
147	95	M2A(32), M3(33), 30 M6(used as AP)	--	--	--	12 Aug
148	69	M3(37), M2A3(32)	30	M6	--	11 Aug
149	29	M3(11), M1A3(5), 13 hand grenades	--	--	--	7 Aug
150	40	M1A3	--	--	--	9 Aug
151	6	M3 --	1	M7	--	6 Aug
152	51	Unknown --	--	--	--	---
153	28	M1A3 --	--	--	--	8 Aug
154	--	(see field 153)	--	--	--	
155	--	Trip flares	--	--	--	6 Aug
156	--	-- --	12	M6	--	6 Aug
157	19	Unknown --	--	--	--	18 Aug
158	--	-- --	6	M6	--	31 July
159	13	M3 --	28	M7	--	9 Aug
160	150	M2(6), M3(144)	--	--	--	6-8 Aug
161	81	M2(60), M3(21)	--	--	--	7 Aug
162	145	M2(62), M3(83)	--	--	--	7 Aug
163	9	M2 --	--	--	--	18 Aug
164	6	M2 --	--	--	--	23 Aug
165	20	M2 --	--	--	--	23 Aug
166	30	M3 --	--	--	--	23 Aug
167	45	M2(39), M3(6)	--	--	--	5 Aug
168	5	M2 --	--	--	--	6 Aug
169	159	M2(70), M3(89)	--	--	--	21 Aug
170	78	M2(43), M3(35)	--	--	--	10 Aug
171	78	M2(30), M3(48)	--	--	--	21 Aug
172	21	M3 --	--	--	--	9 Sept
173	6	M3 --	--	--	--	12 Sept
174	3	M3 --	--	--	--	12 Sept
175	--	-- --	75	M6	--	12 Sept
176	3	M3 --	1	M7	--	6 Aug
177	66	M2 --	--	--	--	6 Aug
178	342	M2A3(35), schu(336)		--	--	11 Aug
179	31	M2 --	--	--	--	6 Aug
180	--	-- --	18	M6	--	8 Sept
181	4	M3 --	--	--	--	9 Sept
182	4	M3 --	--	--	--	9 Sept
183	10	M3(4), M2A3(3), schu(3)	4	M6	--	23 Aug
184	--	--	16	M6	--	21 Aug
185	--	-- --	14	M6	--	21 Aug
186	10	M3(4), M2A3(3), schu(3)	4	M6	--	23 Aug
187	--	--	100	M6	--	8 Aug
188	--	-- --	68	M6	--	8 Aug

Field No.	AP No.	AP Type		AT No.	AT Type		Date
189	--	--	--	251	M6	--	7 Aug
190	36	M3	--	--	--	--	21 Aug
191	9	M2	--	--	--	--	26 Aug
192	40	M2	--	--	--	--	17 Aug
193	17	M3	--	--	--	--	19 Aug
194	16	M3	--	--	--	--	9 Sept
195	2	M3	--	--	--	--	12 Sept
196	7	M3	--	--	--	--	23 Aug
197	9	M3	--	--	--	--	1 Sept
198	15	M3	--	--	--	--	7 Aug
199	9	M3	--	--	--	--	17 Aug
		AREA NO. 5					
1	9	M3	--	--	--	--	9 Sept
2	6	M3	--	--	--	--	9 Sept
		AREA NO. 1					
1	30	M2	--	--	--	--	20 Aug
2	42	M2(30), M3(12)		--	--	--	22 Aug
3	28	M2	--	--	--	--	6 Aug
4	--	--	--	82	M6	--	7 Aug
		AREA NO. 8					
1	4	M3	--	10	M6	--	30 July
2	6	M3	--	18	M6	--	30 July
		AREA NO. 9					
1	101	Schu	--	--	--	--	23 Aug
2	--	--	--	330	M6	--	26 Aug
3	78	Schu	--	--	--	--	26 Aug
4	2	M2	--	9	M6	--	1 Aug
5	2	M2	--	9	M6	--	1 Aug
6	--	--	--	16	M6	--	1 Aug
7	--	--	--	10	M6	--	1 Aug
8	--	--	--	12	M6	--	2 Aug
9	--	--	--	27	M6	--	2 Aug
10	--	--	--	41	M6	--	2 Aug
11	--	--	--	14	M6	--	2 Aug
12	1	Hand Grenade		15	M6	--	2 Aug
13	--	--	--	46	M6	--	2 Aug
14	--	--	--	12	M6	--	2 Aug
15	12	M3	--	--	--	--	27 July
16	4	M3	--	47	M7	--	2 Aug
17	--	--	--	40	6	--	26 July
18	5	M3	--	21	M6	--	31 July
		AREA NO. 10					
1	--	--	--	16	M6	--	26 July
2	--	--	--	5	--	--	30 July
3	--	--	--	130	M6	--	30 July
4	--	--	--	250	M6	--	23 July
5	--	--	--	71	M6	--	26 July
6	--	--	--	31	M6	--	27 July
7	--	--	--	--	--	--	

ANNEX 5

Field No.	AP			AT			
	No.	Type		No.	Type		Date
8	17	M2A1	--	121	M6	--	26 July
9	--	--	--	14	M6	--	1 Aug
10	--	--	--	27	M6	--	29 July
11	--	--	--	30	M6	--	28 July
12	24	M2(11), M3(13)		--	--	--	27 July
13	4	M2	--	--	--	--	27 July
14	--	--	--	28	M6	--	25 July

TOTAL MINE FIELDS REPORTED TO EIGHTH-ARMY ENGINEERS
(14 December 1950-26 January 1951)

Field No.		AP			AT		
		M2	M3	Schu	M6	M7	Date
1.	25th Div.	--	9	--	--	--	16 Dec.
2.	25th Div.	--	--	--	--	30	17 Dec.
3.	25th Div.	141	--	--	--	--	17 Dec.
4.	25th Div.	--	29	--	--	--	18 Dec.
5.	25th Div.	--	15	--	--	--	17 Dec.
6.	25th Div.	40	21	--	--	--	18 Dec.
7.	25th Div.	--	8	--	--	--	19 Dec.
8.	25th Div.	50	--	--	--	--	19 Dec.
9.	25th Div.	92	--	--	--	--	16 Dec.
10.	25th Div.	old NK mine field			--	--	
11.	--	NK mines		--	--	--	
12.	24th Div.	--	15	--	--	--	14 Dec.
13.	24th Div.	--	15	--	--	--	14 Dec.
14.	24th Div.	--	8	--	--	--	14 Dec.
15.	25th Div.	--	9	--	--	--	17 Dec.
	24th Div.	--	9	--	--	--	17 Dec.
	24th Div.	--	12	--	--	--	17 Dec.
	24th Div.	10	--	--	--	--	17 Dec.
16.	25th Div.	12	141	--	--	--	19 Dec.
17.	25th Div.	12	--	--	--	--	18 Dec.
18.	25th Div.	47	--	--	--	--	18 Dec.
19.	25th Div.	--	6	--	--	--	19 Dec.
20.	25th Div.	--	33	--	--	--	23 Dec.
21.	25th Div.	18	--	--	--	--	18 Dec.
22.	25th Div.	--	6	--	--	--	22 Dec.
23.	25th Div.	--	6	--	--	--	22 Dec.
24.	25th Div.	--	12	--	--	--	19 Dec.
25.	25th Div.	--	127	--	--	--	23 Dec.
26.	25th Div.	--	--	--	150	--	21 Dec.
27.	25th Div.	24	9	--	--	--	23 Dec.
28.	25th Div.	--	36	--	--	--	25 Dec.
29.	25th Div.	--	--	--	30	--	25 Dec.
30.	25th Div.	--	57	--	--	--	22 Dec.

APPENDIX I

Field No.	AP			AT		Date
	M2	M3	Schu	M6	M7	
31. 25th Div.	--	18	--	--	--	23 Dec.
32. 25th Div.	--	--	--	9	--	2 Jan.
33. 24th Div.	--	--	--	11	--	3 Jan.
34. 24th Div.	--	--	--	9	--	2 Jan.
35. 25th Div.	40	68	--	--	--	7 Jan.
36. 7th Div.	9	--	1	--	--	9 Jan.
	5	--	--	--	--	
	10	--	--	--	--	
	5	--	24	--	--	
	6	--	2	--	--	
	3	--	4	--	--	
	4	--	6	--	--	
	4	--	10	--	--	
37. 24th Div.	--	--	--	30	--	14 Jan.
38. 24th Div.	(Improvised field)*			--	--	21 Jan.
39. 24th Div.	65 grenade-TNT-AP			--	--	20 Jan.
40. 24th Div.	--	--	99	--	--	23 Jan.
41. 24th Div.	--	--	50	--	--	22 Jan.
42. 24th Div.	--	--	50	--	--	22 Jan.
43. 7th Div.	--	6	--	--	--	12 Jan.
44. 7th Div.	--	15	--	--	--	12 Jan.
45. 7th Div.	--	12	--	--	--	12 Jan.
46. 24th Div.	--	45	375	234	--	15-25 Jan.
47. 24th Div.	--	--	443	--	--	25 Jan.
48. 24th Div.	--	--	282	(Changhowon)		24 Jan.
49. 24th Div.	--	--	90	(Changhowon)		25 Jan.
50. 25th Div.	165	--	--	--	--	25 Jan.
51. 25th Div.	52	--	--	--	--	26 Jan.
52. 25th Div.	--	23	--	--	--	26 Jan.
53. 25th Div.	41	47	--	--	--	27 Jan.
54. 25th Inf.	--	31	--	--	--	27 Jan.
55. 25th Inf.	--	15	--	--	--	28 Jan.
56. 25th	--	159	--	--	--	?
57. 25th	79 grenade-TNT-AP**			--	--	20 Jan.

* Nails taped to TNT charge with 15-second delay firing device.

** Each was a 2.5 pound TNT charge on a stake. Next to the charge were placed a grenade in a container and loose shrapnel wrapped in a cloth.

SUMMARY OF QUANTITIES USED

	M2	M3	Schu	M6	M7
Total	790	1022	1436	473	30

APPENDIX I, ANNEX 6:

USE OF EARTH AUGERS FOR LAND-MINE EMPLACEMENT

PROBLEM

The purpose of this study is to evaluate the performance of power earth augers in the emplacement of land mines.

FACTS

A proposal was presented by the Operations Research Office for the use of power earth augers in the emplacement of land mines in Korea.

Field tests were carried out in Korea to test the feasibility of using power earth augers in land-mine emplacement.

DISCUSSION

Introduction

In organizing these tests, primary consideration was given to: (1) the feasibility of the earth auger in terms of its mechanical performance, durability, and speed of operation, and (2) the detectability of mine fields emplaced using the earth auger. Three mine fields were placed and, in addition, a large number of holes was dug with the power augers to check the influence of soils and road type. For a comparison, Korean labor was used at one site to dig in competition with the augers in a main supply route (MSR). The effectiveness of the emplacements from a camouflage standpoint was ascertained by air observation and by air and ground photographs (see Figure 1).

Equipment

The Signal Corps furnished two types of power auger, the K-44 (see Figure 2) and the V-18 "earth borers." Tests showed that the V-18 performs more satisfactorily off the road than does the K-44 because of better traction. However, the K-44 digs faster in the roads than the V-18 by a factor of 1.5. These truck-mounted units are independent, each carrying its own set of auxiliary tools. In addition to the driver and operator, the

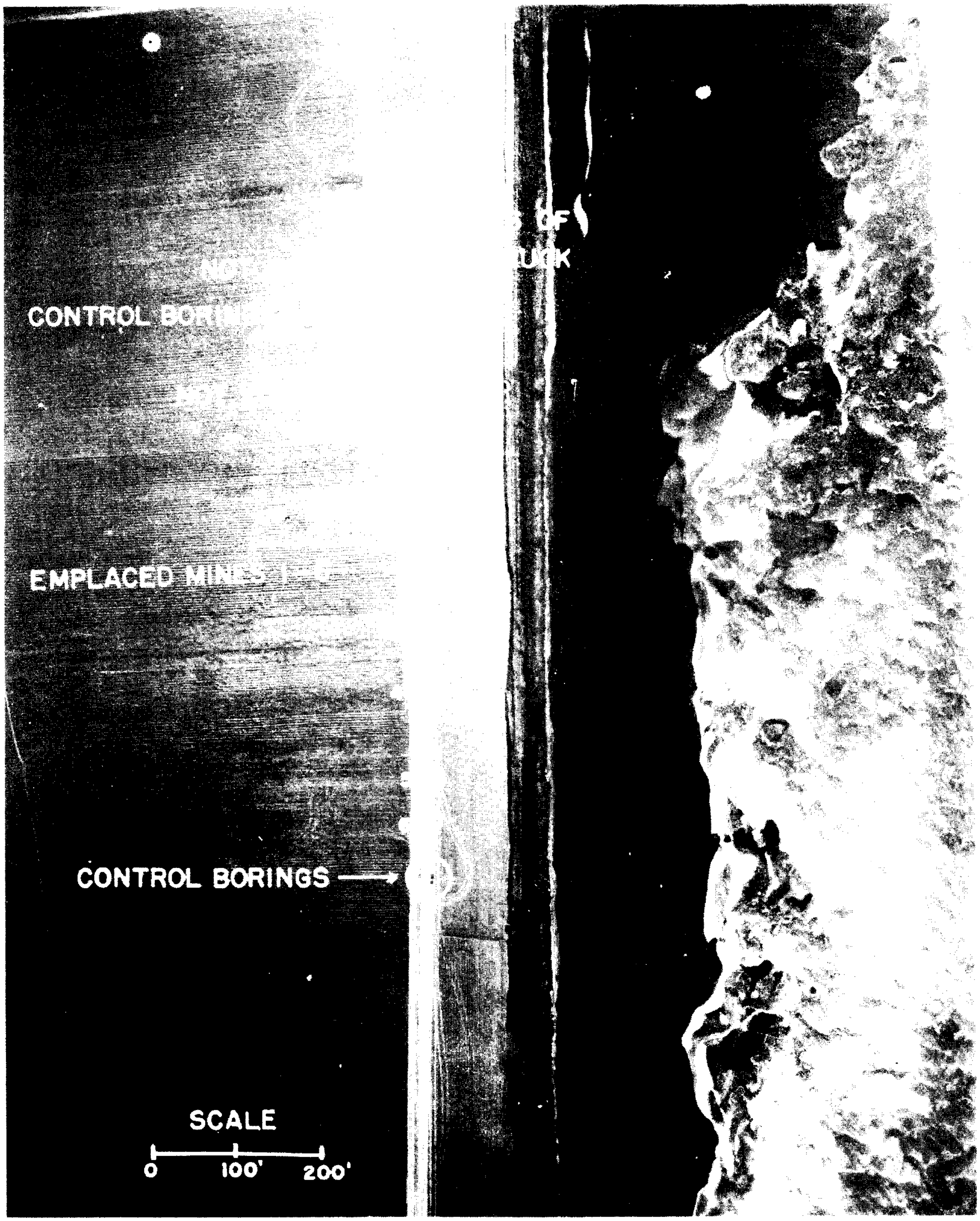


Figure 1.--Aerial photograph of earth-auger plants along MSR.


3

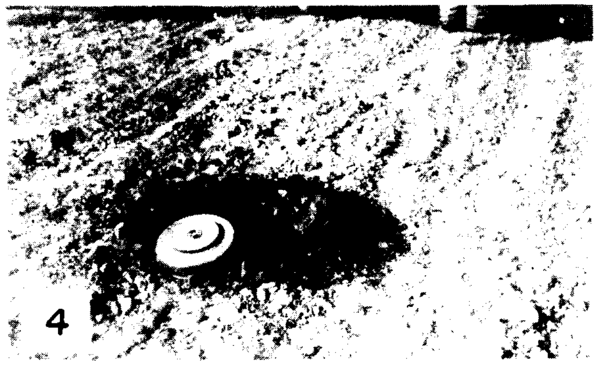

4

Figure 2.--The "Earth Borer" digging on an MSR near Taegu. The road surface is 8 inches deep and consists of a dense traffic-bound gravel-clay mixture.


2

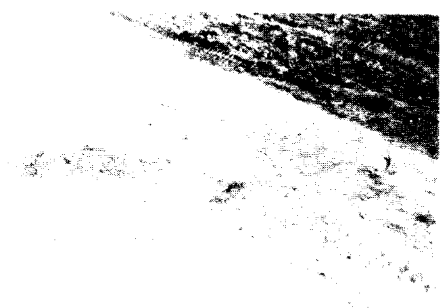
Figure 3.--A 14-inch diameter hole cut in an MSR to a depth of 14 inches for the placement of a three-mine group. The Korean "team" stands by.

Figure 4.--An unfuzed land mine (13 inches in diameter) prepared for placement in a cultivated field. The faint trace of wheel tracks seen here can be clearly seen in Figure 1.

Figure 5.--A mine covered with the excavated soil appears as a dark spot because of the damp soil. The extra material involved in deep holes makes them much harder to disguise than the one-mine holes.

Figure 6.--The emplacement was filled completely with dry soil. The field trials showed that if only a thin surface cover of dry soil was used, this cover became damp in a day's time and was almost as dark as that shown in Figure 5.


5


6

truck can carry 50 mines and the three Korean laborers needed to plant mines and clean up at each location.

During these tests, the power augers were not found difficult to maintain and the auger bits proved to be capable of drilling satisfactorily in the following soils: (1) soft soils (silt, silty clay, and sand); (2) four inches of packed silty clay; and (3) gravel or crushed stone to the depth of eight inches. The first of these consisted of flood plains, paddies, and sand flats; the second of secondary roads; and the third of MSR's. Mobility of the earth-auger vehicle was not a limitation on the operations, since it proved able to operate on and off the roads during these tests.

The mines were supplied by Ordnance. They were the standard antitank mine, 13 inches in diameter and approximately 3.5 inches thick. When armed, the fuze projects an additional two inches above the body of the mine. These mines are shipped in metal frame boxes complete with fuzes for either antitank or antipersonnel use.

Test Procedure

The mines were distributed at random to reduce the possibility of visual detection. Since detection either from the ground or the air is facilitated by the recurrence of the same feature at uniformly spaced intervals or along a straight line, random distribution reduces the possibility of visual detection through such means of observation. In these tests, for example, the spacing along an MSR (measured along the centerline of the road) varied from 10 to 60 feet; the arrangement along the road was staggered by placing the mines at various distances left and right of the centerline. Mines were planted in the following manner:

Mine field no. 1: This was placed on an MSR, and the traffic was by-passed. This simulated a normal mine field placed during a "strategic withdrawal."

Mine field no. 2: Mines were planted along a 300-yard length of MSR "Red Diamond." This field was established to simulate conditions applying to the detection of "radio controlled" mines or others having a time lag between planting and activation.

Mine field no. 3: This was placed on a typical "secondary" road, one of the earth roads that branches off of MSR "Red Diamond."

Miscellaneous: Numerous individual holes and groups of holes were dug in the sand flats at the junction of the Naktong and the Kumho Rivers, silty flood plain soils, and in a number

of different paddy areas where the soil approached a clay texture.

With this grouping of mine fields and experimental diggings the problems of the various soils and the typical Korean roads were explored. The power earth auger proved suitable to meet the various demands imposed by the typical Korean soils and roads tested. The time involved on the roads should not be applied to other than Korean roads except when exact knowledge on road construction is available. In most of Europe, for instance, the roads have less base thickness, whereas the type of construction used in French colonial areas (such as in Africa and Indo-China) will not permit the use of the power auger because of the large stone blocks used for foundations. The data shown in Table I are applicable to Korean roads and soil.

Although the mines were not fuzed for the field test, several runs were made to determine the time required to unpack and ready them for installation. On placement of two- and three-mine combinations (see Figure 3) and on one mine reinforced with 40 pounds of dynamite, the time was kept to determine the added time required to emplace more than one mine.

Results of these tests are tabulated in Table I and discussed in the paragraphs following.

TABLE I

SINGLE-MINE EMPLACEMENT

Item	Location	Material	Auger 1/ (Min.)	Korean Labor 2/ (Min.)	Emplacements Per Hour
1	MSR	6-8" of gravel or crushed stone	6	4	10
2	Secondary roads'	4" of packed silty clay	3	4	18
3	Sand flats	Sand	1.5	3	40
4	Paddies	Silty clay	1.5	3	40
5	Flood plains	Silt	1.5	3	40

1/ Time necessary to dig 1 empacement and move to next site.
2/ Time necessary to plant the mine, fill the hole, and move to the next site.

In items 1 and 2 of Table I, digging requires most of the time; moving varies with the distance but does not exceed one minute. As for items 3, 4, and 5, digging requires from 10 to 20 seconds; the moving time predominates in these cases. In these latter three classes of ground, therefore, the use of six

Koreans (double the number used in all of these tests and found satisfactory for the requirements of items 1 and 2) is recommended in order to obtain maximum results from the powered equipment.

In comparison with these results, it was found that three Koreans using hand tools could plant two one-mine units per hour. The hand-labor test showed also that hand labor on multiple-mine plantings or a mine supplemented with dynamite is not practical on an MSR.

Digging in frozen road bases presents substantially the same problem as digging in frozen soil. However, frozen road bases are more easily penetrated because of their granular nature.

It was observed that a single mine will require a hole six to eight inches deep, the hole being drilled with a 14-inch diameter auger. The powered units are equipped with a set of augers ranging from 8 to 20 inches in diameter. The greatest difficulty is experienced in digging the first eight inches of the roads. Below that depth, as it does in the fields, the auger digs very fast. For example, at one site on an MSR it required six minutes to dig through eight inches of road base and 45 seconds to dig an additional four feet in the subgrade. Very little extra time was required to dig either the hole for the placement of one or two extra mines or for the placement of a mine and a charge of dynamite. One minute added to the digging cycle will cover the additional time required for any combination greater than one mine.

Detection

Considerable attention was paid to the detection part of the experiment. Proper camouflage is needed since once a mine field has been detected it can be mapped in detail with a continuous strip film camera, such as the Sonne type available in this theater. Missions for air observation by T-6 (Mosquito) observers and aerial photographs were made. The T-6 made its first reconnaissance within a few hours after the completion of the mine emplacement, and nothing was seen but the open holes that were used as reference points at the beginning and end of the fields. Photography was scheduled for three succeeding days after the installations. Cooperation was good, but on one occasion the target was missed and groups of refugees on the road in another instance prevented the securing of complete evidence for all of the missions.

There are two types of signs that reveal mined areas. The first of these are the signs resulting from the planting of mines. They will indicate unusual activity and thereby "incriminate" the otherwise innocent spots scattered along the road. Every off-the-road vehicle track can be seen with perfect

clarity. Therefore, vehicles driving around a mined area will leave many obvious signs that a good section of road has been avoided. For the same reason, it is going to be impossible to disguise the fact that an earth auger (or truck) has been driven from place to place in a field, stopped, and disturbed the soil. Figures 1 and 4 show the wheel tracks made by the earth auger trucks. In Figure 1 it will be seen also that wheel tracks made at least one season ago have not been entirely obliterated by later cultivation of the fields.

The second "sign" of the presence of mines is the spot appearance of the installations themselves (see Figure 5). The recurrence of similar spots more or less closely spaced implies that they are in some way associated. The random distribution of the mines themselves is the first and best means to disguise this. Random distribution and relatively wide spacing will reduce the possibility of visual detection to a minimum without materially reducing the probability of having the mine detonated. Neutralizing the field by hand methods also is complicated to an equal degree. The situation is ideal for the use of remote control in arming and unarming the mines.

A suggested rule of thumb for random mine emplacement is: three adjacent mines should not fall in a straight line; minimum spacing should be 20 feet. Using unit groups of three holes, the space between the second and third should vary from 2 to 4 times the distance between the first and second. Similar spacing should not be used in the same field.

The final step in preventing visual detection is the covering of the mine itself and the disposal of excess material. The final covering of the mine consisted of brushing the area lightly with burlap and then sprinkling the damp spot with dry soil or loose material from the road shoulders. At the time this was very effective. It made it difficult to walk back and locate a spot ten minutes later, and it also accounts for the fact that T-6 (Mosquito) observation could not find the mines several hours later. One and two days later the spots showed clearly because the added time gave the damp soil in the hole an opportunity to moisten the dry covering. By the third day the dry windy weather and sunshine had reversed the trend and 80 percent of the "mines" were only faintly visible.

To overcome the spot left by the damp soil, dry soil was collected from the road and road shoulders to fill the hole. This proved to be quite satisfactory (see Figure 6). Proper operating technique will prevent a wide scattering of soil during the auger's operation. Excess soil resulting from the auger operation need not present camouflage problems. Its disposal is a matter of operating technique. In these tests, where excess soil remained, it was placed in sacks and scattered in the ditches rather than dumped at one place.

CONCLUSIONS

1. Models K-44 and V-18 power earth augers can be used efficiently and satisfactorily in the laying of mine fields; 10 mines per hour can be emplaced in MSR's, 18 in secondary roads, and 40 off the roads.

2. Model V-18 is preferred for off-the-road work because of better traction. The K-44 digs faster in the roads than the V-18 by a factor of 1.5.

3. The power earth auger can operate as an independent unit carrying its own crew, the required three laborers used in filling the holes, and a load of 50 mines.

4. Three Koreans using hand tools can plant two one-mine units per hour. The use of hand labor on multiple mine plantings or a mine supplemented with dynamite is not practical on a MSR.

5. Random planted mines are much more difficult to detect than those in a regular pattern; air observation can detect the standard "rectangular" pattern of closely spaced mines but cannot detect the random distribution.

6. None of the installations could be seen on a MSR where traffic had passed over the field. (This assumes radio or time-delay activation of mines after a certain elapsed period.)

7. Proper and rapid emplacement with effective camouflage requires trained, conscientious workers.

8. Random mine patterns are difficult to detect by air photo interpretation.

9. Once detected, a mine field can be mapped in detail with a continuous strip film type camera.

RECOMMENDATIONS

1. Signal Corps power augers should be used for the mining operation.

2. Random planting is essential to prevent detection.

3. Road mines should be covered with dry material obtained from the road surface rather than the moist soil taken from the hole. In fields, top soil should be used rather than sub-soil because of color changes.

4. All waste soil should be scattered rather than dumped in a heap.

5. Air observation and air photos should be used as a means of land mine detection. To detect mine fields on cultivated ground a 1:5000 scale is probably satisfactory; on roads a 1:2000 is a minimum scale.

APPENDIX I, ANNEX 7:

ENEMY EMPLOYMENT OF LAND MINES IN KOREA
(From 21 January to 8 April 1951)

For the period 21 January to 8 April 1951 there were 91 US armor casualties caused by land mines, of which 20 were total losses. Mines thus continue to be the most destructive weapon against US armor. The high casualties far exceed those due to bazookas in the same period (5 casualties, all total losses), and those due to mortars which numbered 3, of which only one was a total loss. Many other vehicles also were damaged or destroyed by land mines in this period. It is believed that some of the casualties were caused by unreported UN mine fields put in previously.

The enemy has increased his mine activity and continued the use of random mine emplacements with a variety of deceptive features. US forces are sweeping the roads for mines. Several instances have been found of craters being made in the road and an AT mine put on the edge of the crater. Mines are being put down to a depth of two feet or more in the road and covered with rocks. This makes detection and probing difficult and also may allow one or more vehicles to pass before the mine detonates. Mines have been placed in fords and have been set to detonate under the weight of a jeep. These mines have completely demolished jeeps. Mines are being put in likely bivouac or artillery areas to cause damage to trucks and other vehicles.

One report states that the CCF dug a hole 6 ft square by 3 ft deep and placed two mines in the hole, barely covering them by fill. It was intended that UN forces later fill in the hole, without detecting the mines, and eventually, as the road wore down a vehicle would set the mines off. Many dummy holes have been dug and filled to suggest mine emplacements, while many other holes have had only scrap metal in them.

The use of a shaped charge placed in the center of the road was reported encountered 30 January 51. It was reported by the 2nd Engineer Control Battalion that a tank was damaged by a heavy mine on a road which had been swept and probed. Fragments of a plastic material were found near the crater, and it was thought

that a new plastic type of mine may have been used. Another mine emplacement used by the enemy requires undermining the road from the shoulder inward and placing AT mines in the hole. No disturbed earth is visible on the surface of the road. In other cases the enemy has dug holes in the road and then offset the mines under the undisturbed portion of the road. Probing the loose dirt has revealed no mines. Several vehicles have been damaged by mines laid in this manner.

In general, land-mine usage has greatly increased in the period 21 January to 8 April and has been successful in causing delay and damage to UN forces.

APPENDIX J

MECHANICAL RELIABILITY AND COMBAT ZONE FUEL LOGISTICS OF UN TANKS

SUMMARY

PROBLEM

The problem is to evaluate on the basis of Korean experience the mechanical reliability and gasoline consumption of UN tanks.

FACTS

In the period 1 July 1950-21 January 1951 there were 576 UN tank casualties, of which 256 were nonrecoverable.

Sixty percent of the total casualties and forty percent of the total losses were due to mechanical failures.

The percentage of issued tanks with mechanical troubles requiring evacuation to ordnance was:

Tank	Percent
M4A3	20
M24	34
M26	40
M46	40

The fuel consumption for US tanks in Korea has been:

Tank	Gasoline Consumption (gal/mile)
M24	1½
M4A3	2½
M26	3
M46	4½

For the Centurion, the figure has been 3.8 gal/mile. It is estimated that for the T42 the gas consumption would be 3.3 gal/mile.

DISCUSSION

The number of mechanical failures has been due partly to the rough terrain and partly to the fact that the M4's and M26's were veterans of World War II, and had either been stored for a considerable time or used for training purposes. The M46, on the other

hand, was a new and untried tank, with several novel features. Nevertheless, the high incidence of mechanical failure indicates considerable room for improvement in the reliability of US tanks.

Fuel consumption figures show that the family of water-cooled, gear-driven and manually-controlled tanks have a linear relation between tank weight and gasoline consumption, i.e., approximately 0.065 gallons per ton mile. The M46 and T42, with hydraulic tongue-converters, appear to be less efficient on a ton-mile consumption basis by about thirty percent.

CONCLUSIONS

Over-all, the M4A3 has been twice as reliable mechanically as the M46 in Korea. It is recognized that the M46 will improve greatly in reliability as its early production weaknesses are eliminated.

The air-cooled engine of the M46 has been the most reliable tank engine.

The M46 transmission has had the least mechanical reliability among the tanks in Korea.

The reason for the high terrain loss of the M4A3 as compared to the M46 is undetermined, but may be due to:

1. Lower driver fatigue in the M46 because of hydraulic drive and control.

2. Greater mobility in the M46 owing to the higher power/weight ratio, hydraulic drive, and better tracks.

3. Use of the M4A3 in more dangerous terrain.

The high loss of tanks from mechanical failure was due mainly to their failure to stand up to sustained road marches during withdrawal. Almost all tanks could have been recovered and repaired during an advance or in a static combat situation.

The high gasoline consumption of the M46 as compared to the M4A3 is partly due to the excess weight of the M46, and partly to a thirty percent lower over-all efficiency. The cause of the lower efficiency in the M46 and T42 is believed, but not proved to be, the hydraulic drive.

The excess logistic requirements necessitated by the higher gasoline requirement of the M46 is an adverse factor in the use of this tank.

On the basis of 10,000 tanks running 600 miles per month in Europe, the use of the T42 in place of the M46 would save sufficient

fuel for 300 daily F80 sorties. If a T42 with a gear transmission instead of a hydraulic transmission were used, it is estimated that the saving would provide fuel for 500 daily F80 sorties.

Not documented in this appendix, but demonstrated elsewhere in this report, is the substantially equal combat effectiveness of the M4A3 as compared with the M46 in Korea.

RECOMMENDATIONS

In view of the high incidence of mechanical failures, US tank designers should make a maximum effort by a research and development program to improve the mechanical reliability of tanks.

For production in the US, the medium tank with the lowest possible weight for equivalent performance on the battlefield should be chosen. Since it is believed that the T42 could be equal or superior to the M46 on the battlefield, it should, for the reason given above, supplant the M46 at the earliest possible moment.

A T42 with a gear transmission should be given serious consideration.

MECHANICAL RELIABILITY AND COMBAT ZONE FUEL LOGISTICS OF UN TANKS

PROBLEM

The problem is to evaluate, on the basis of Korean experience, the mechanical reliability and gasoline consumption of UN tanks.

FACTS

Allied tank losses and tanks from 1 July 1950 to 21 January 1951, by type, are shown in Table I. Figures in parentheses indicate nonrecoverable losses; casualty figures not in parentheses show the total casualties including the nonrecoverable tanks.

An analysis of the cause of mechanical failure gives the results found in Table II.

The percentage of tanks issued that have become casualties is given in Table III.

The figures in the third column of Table III for nonrecoverable losses are all approximately twenty percent with the exception of those for the M32.

TABLE I

ALLIED TANK LOSSES AND TANKS ISSUED
1 JULY 1950 TO 21 JANUARY 1951

Casualty Causes	M46	M26	M45	M4A3	M32	M24	Centurion	Churchill	Cromwell	Total
	TANK TYPE									
Mechanical Failure	72 (32)	102 (24)	6 (0)	105 (40)	15 (2)	38 (7)	7 (1)	2 (0)	-- --	347 (106)
Tank Fire	1 (0)	3 (2)	-- --	11 (7)	-- --	2 (2)	-- --	-- --	-- --	17 (11)
Infantry	1 (1)	3 (3)	-- --	3 (3)	2 (2)	1 (1)	-- --	-- --	12 (12)	22 (22)
Terrain	2 (2)	8 (7)	2 (0)	33 (31)	1 (1)	5 (5)	-- --	-- --	-- --	51 (46)
Mine	3 (0)	24 (3)	-- --	33 (14)	2 (1)	2 (0)	-- --	-- --	-- --	64 (18)
Antitank Fire	-- --	4 (2)	-- --	15 (11)	-- --	7 (4)	-- --	-- --	-- --	26 (17)
Mortar	-- --	3 (0)	-- --	4 (0)	-- --	1 (1)	-- --	-- --	-- --	8 (1)
Tactical Cause	-- --	9 (9)	-- --	8 (8)	1 (1)	3 (3)	-- --	2 (2)	-- --	23 (23)
Artillery	1 (1)	-- --	-- --	6 (4)	-- --	1 (0)	-- --	-- --	-- --	8 (5)
Accident	7 (4)	-- --	-- --	2 (2)	-- --	1 (1)	-- --	-- --	-- --	10 (7)
Total	87 (40)	156 (50)	8 (0)	220 (120)	21 (7)	61 (24)	7 (1)	4 (2)	12 (12)	576 (256)
Number Issued	173	252	8	516	71	113	64	20	14	

APPENDIX J

FACTS

TABLE II

MECHANICAL FAILURES OF DIFFERENT TANKS

Mechanical Failure	Types M46	M26	M4A3	M32	M24	M45
Engine	7	26	31	4	12	-
Transmission (including clutches)	15	10	10	3	7	-
Tracks, final drive suspension	6	13	18	4	2	1
Cooling system (including radiators)	6	15	4	-	-	1
Lubrication system (including oil lines, coolers)	14*	11	2	-	1	3
Engine accessories (aux generators, starters, intake manifolds)	3	3	3	1	-	-
Gun (including recoil mechanism)	3	4	2	-	-	-
Turret (including traverse)	-	2	2	-	-	-
Steering	1	4	3	-	-	-
Electrical System	9**	1	2	-	1	-
Gas Tanks	2	2	-	-	-	-
Fair Wear and Tear (including general repairs)	10	8	8	-	5	-
Freezing	-	5	3	-	-	-
Unspecified	-	-	24	4	2	-

* All oil cooling system
** All master junction boxes

TABLE III

PERCENT OF ISSUED TANKS DAMAGED AND NONRECOVERABLE

Tank	Casualties (Percent)	Nonrecoverable (Percent)
M26	61.9	19.8
M24	53.9	21.2
M46	50.3	23.1
M4A3	42.6	23.3
M32	29.6	9.9

The percentage incidence of mechanical failure in US tanks has been as follows:

TABLE IV

PERCENT OF ISSUED TANKS WITH MECHANICAL FAILURES

Tank	Percent
M4A3	20
M24	34
M26	40
M46	40

The fuel consumption, which units have estimated for road marches in Korea, is shown in Table V.

TABLE V

GASOLINE CONSUMPTION FOR DIFFERENT TANKS

Tank	Gasoline Consumption (gallons per mile)
M24	1½
M4A3	2½
M26	3
M46	4½

DISCUSSION

1. Reliability of US Tanks

The most striking feature of Table I is the number of casualties due to mechanical causes, representing sixty percent of the total casualties, and forty percent of the total losses. It should be realized, however, that the M4's and M26's were veterans of World War II and had in many cases been stored for a long period or used for training purposes. The M46's, on the other hand, were new tanks that had not been fully tried, and their reliability can be expected to improve greatly when some of the weaknesses brought out by the Korean campaign are corrected.

Of the 107 tanks that became total losses because of mechanical failure, 102 had to be abandoned or destroyed when UN forces were withdrawing. Nearly all these tanks could have been repaired or evacuated had sufficient time or means of removal been available. During the withdrawal from North Korea, tanks were required to make long road marches, and there was neither the time nor equipment to repair vehicles which broke down on the way. It is understood that because of logistical limitations a considered risk was taken by command in building up class 1, 3, and 5 supplies

at the expense of class 2 and 4 in North Korea; the resulting shortage of spare parts added to the difficulties of keeping tanks in operation.

More mechanical failures are shown in Table II than in Table I because several tanks broke down more than once.

The most reliable engine appears to be the air-cooled motor of the M46, but this tank has had the most trouble with the transmission, and many failures in the electrical and oil-cooling systems. Considerable difficulty has been experienced with the cooling system of the water-cooled M26, which has the highest incidence of engine failure.

Although records for the M4A3 are incomplete, the engine appears to be next in reliability to the M46, and the transmission and cooling systems have given considerably less trouble than in the heavier tanks. The M24 has had a high rate of engine failure, approximately ten percent, nearly the same as the M26, and has had the next highest rate of transmission failure to that of the M46. The M24 has also had the most trouble with the gun, particularly with the recoil mechanism. The proportion of track and final drive casualties is about the same for all types of tanks.

Although the M4A3 has proved to be the most reliable tank in Korea mechanically, it has had the highest rate of loss because of terrain difficulties, which might indicate lack of mobility. As the tank has an adequate power-to-weight ratio, the cause may be lack of sufficient traction owing to its narrow track. There may also be some basis for the opinion that driver fatigue in the M4A3 will be high because of its manually-controlled tracks, as compared to the hydraulically-controlled tracks of the M46, and that this may account for some of the terrain accidents. The high terrain loss can probably be explained mainly, however, by the fact that the regimental tank companies had M4A3's and that these companies, having more missions in support of infantry, tended to operate in more dangerous terrain. The M4A3 has proved less able to withstand mine and antitank damage than the heavier M26's and M46's, which might be expected on account of its having less armor; of the eight tanks that have been knocked out by bazookas, seven have been M4's.

The figures for mechanical failures in the report were based on unit records of tanks evacuated to ordnance, and do not include minor items repaired by company or battalion maintenance. In this respect the comparison may be unfair to the M46, as it has been the policy of one battalion to evacuate nearly all tanks with mechanical troubles to ordnance instead of attempting to make unit repairs.

2. <u>A Logistic Comparison of US Tanks</u>

a. Shipping:

(1) From the Technical Analysis Branch, GHQ Transportation Section, the following freight rates for tanks have been obtained:

Detroit to San Francisco--50-ton flat car = $450
San Francisco to Korea--M.S.T.S. Charter = $0.44 per cubic foot

The tank dimensions are:

T42--18'11" long x 11'8" wide x 9'6" high-2080 cu ft
M46--20'9" long x 11'6" wide x 9'1" high-2150 cu ft

Thus, the cost for transporting the T42 tank from Detroit to Korea is $1,365 and for the M46 is $1,395. The cost differential is $30 per tank in favor of the T42 tank, and monthly differentials on shipments of various quantities of T42 per month as compared with equal monthly quantities of M46's is shown in Table VI.

To the cost of the basic delivery must be added the cost of the monthly replacements. The planning factor used by Ordnance for replacements is fourteen percent, and the cost difference is increased by this percentage.

TABLE VI

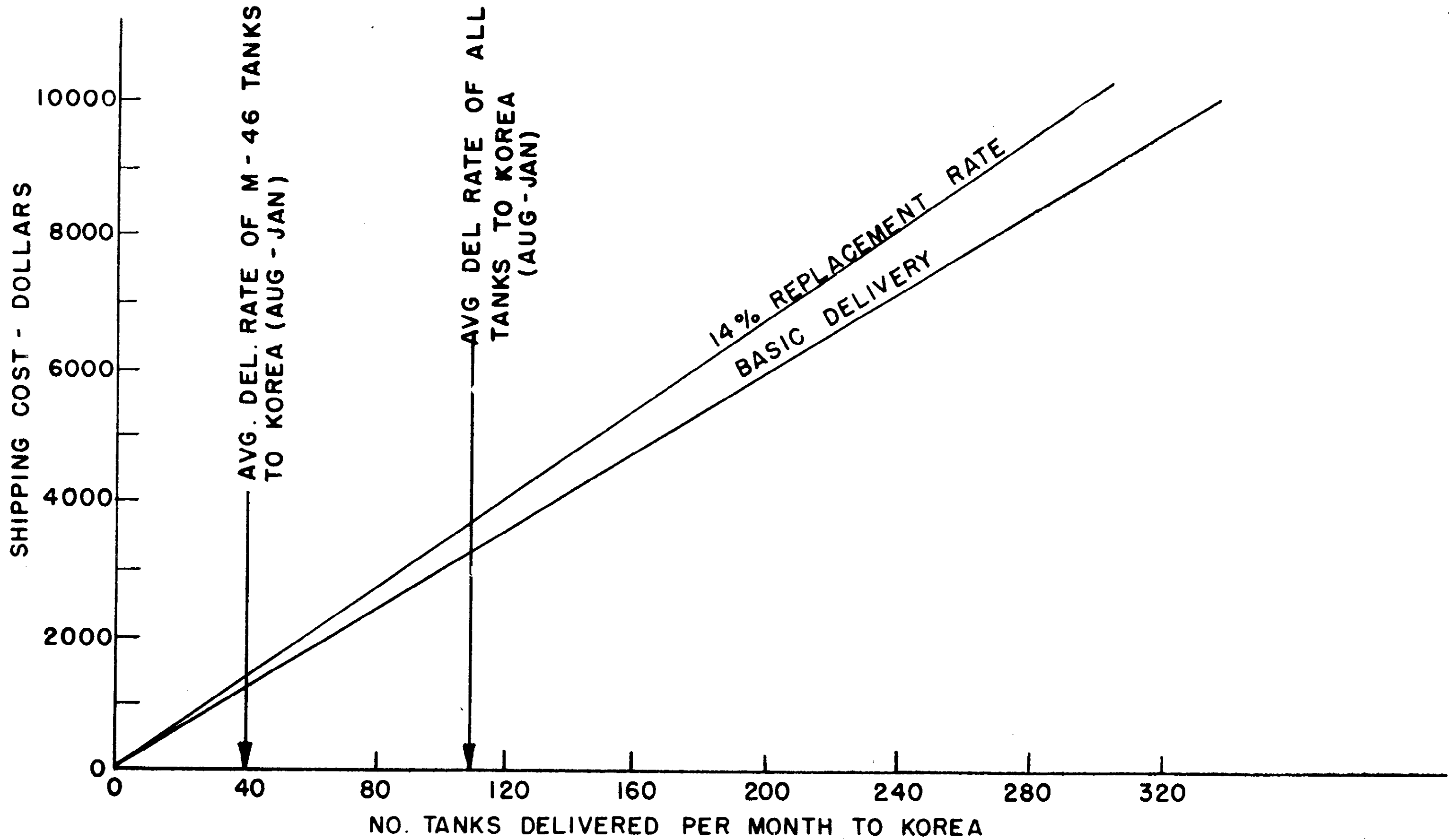
MONTHLY COST DIFFERENTIALS ON SHIPPING

T42 TANKS AS COMPARED WITH M46's

Delivery Rate Per Month	Difference Between M46 and T42 Transportation Costs Per Month
40	$1200
80	2400
120	3600
160	4800
200	6000
240	7300
280	8400

(2) For the period 10 August 1950 to 10 January 1951, 239 M46 tanks and 308 M26 tanks were delivered to Korea. The average monthly rate for the M46 tanks is approximately forty per month, and the average monthly rate for all tanks is 110 per month. Figure 1 shows the shipping costs saved per month by shipping the T42 tanks to Korea in place of M46 tanks.

FIG. 1 DOLLARS SAVED PER MONTH BY SHIPPING T-42 TANKS TO KOREA IN PLACE OF M-46 TANKS VS. MONTHLY DELIVERY RATE



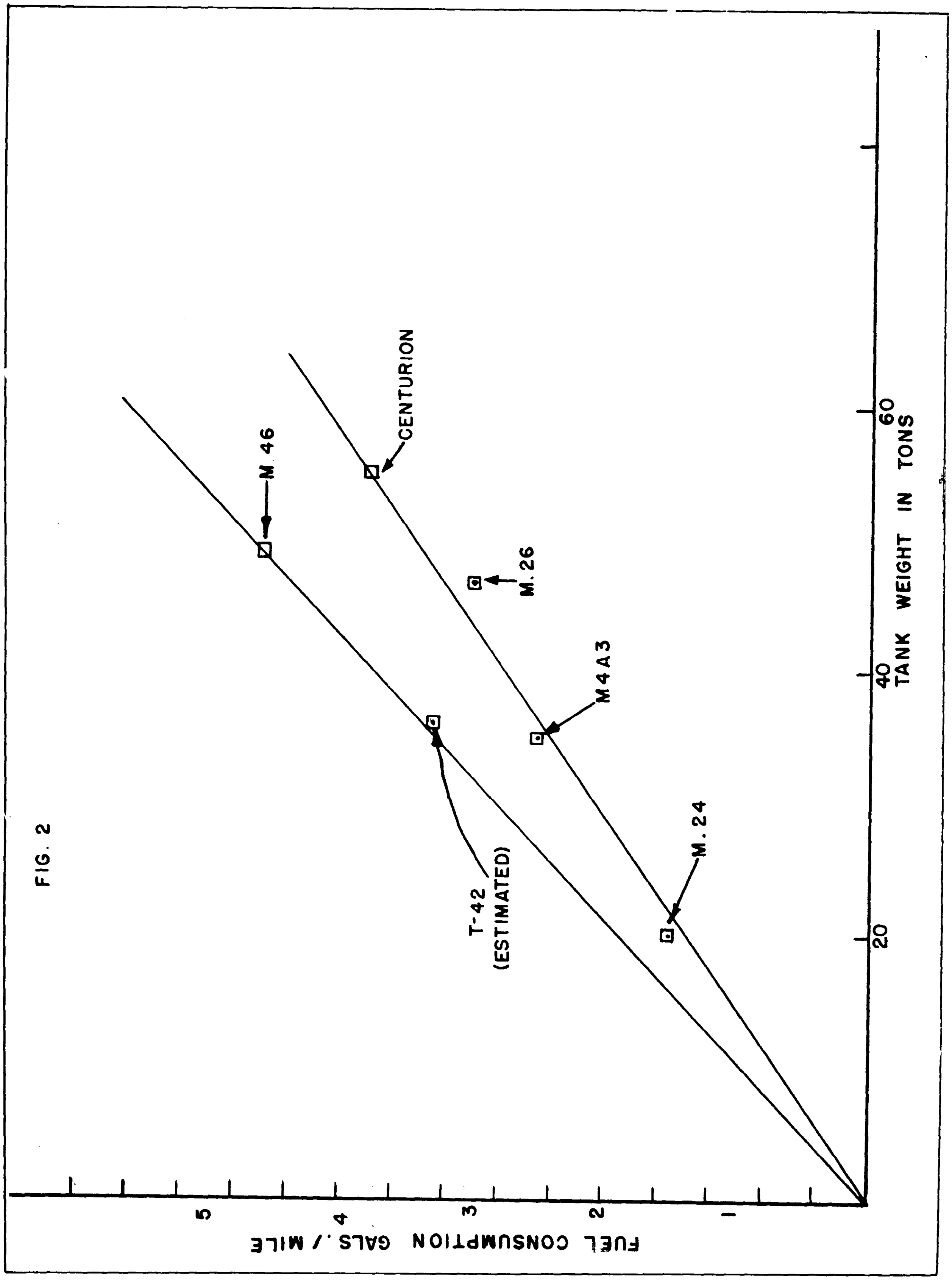


FIG. 2
M.46
CENTURION
M.26
M4A3
M.24
T-42
(ESTIMATED)
20
40
60
TANK WEIGHT IN TONS
1
2
3
4
5
FUEL CONSUMPTION GALS./MILE

DISCUSSION

b. Combat Zone Fuel Logistics

(1) Based on the assumption that 1200 tanks are operating in Korea over a six-month period, it is of interest to show the savings in fuel realized by employing the M4A3 or the T42 tank in place of the M46.

(2) The gasoline consumption for various US tanks in Korea is given in Table V. The gasoline consumption for T42's has been estimated by Ordnance Section, GHQ, to be 3.3 gallons per mile, and that of the Centurion in Korea as about 3.8 gallons per mile. Figure 2 is a plot of tank weight in tons versus gasoline-consumption in gallons per mile. For the family of water-cooled, gear-driven and manually-controlled tanks there is a linear relation between tank weight in tons and gasoline consumption, i.e., approximately 0.065 gallons per ton-mile. It is striking that the M46 and T42 are less efficient on a ton-mile consumption basis by about thirty percent. There is no evidence to show the cause of this, although a contributory cause may be the known inefficiency of hydraulic torque-converters at low speeds.

From these data Tables VII and VIII are derived.

TABLE VII

FUEL CONSUMED PER MONTH BY 1200 TANKS

Tank Miles Per Month	M4A3 (gallons)	T42 (gallons)	M46 (gallons)
200	600,000	792,000	1,080,000
400	1,200,000	1,584,000	2,160,000
600	1,800,000	2,376,000	3,240,000
800	2,400,000	3,168,000	4,320,000
1000	3,000,000	3,960,000	5,400,000

TABLE VIII

DIFFERENCE IN FUEL CONSUMED IN SIX MONTHS

Tank Miles Per Month	M46-M4* (gallons)	M46-T42** (gallons)
200	2,880,000	1,728,000
400	5,760,000	3,456,000
600	8,640,000	5,184,000
800	11,520,000	6,912,000
1000	14,400,000	8,640,000

* The difference between fuel consumed in the M4A3 tanks and in the M46.

** The difference between fuel consumed in the T42 tank and in the M46.

(3) The difference in fuel requirements can now be converted into numbers of fuel tankers required to deliver the excess fuel quantities and the number of rail tank cars and trucks required to deliver this fuel to the tank units. It is assumed that the fuel is transported by tanker from San Francisco to Pusan and then by rail from Pusan to a railhead 260 miles north on the Korean peninsula. From the railhead the fuel is assumed to be barreled and moved by $2\frac{1}{2}$-ton trucks a distance of 50 miles.

An ocean-going tanker makes good 240 nautical miles per day,* has a total port-time of 30 days and travels 5000 nautical miles from San Francisco to Pusan. The tanker capacity is taken as 5,922,000 gallons. Tanker turn-around time is computed as:

$$\frac{2 \text{ x Distance}}{240 \text{ N.M./day}} + \text{port time,}$$

$$\text{or } \frac{2 \text{ x } 5000}{240} + 30 = 71.7 \text{ days turn-around time.}$$

In six months, or 180 days, each tanker will make

$$\frac{180}{71.7} = 2.5 \text{ round trips}$$

Table IX shows the number of tankers required to move the differences in fuel consumed by the three types of tanks in six months.

TABLE IX

TANKERS REQUIRED TO SUPPLY FUEL DIFFERENCES FOR SIX MONTHS

Tank Miles Per Month	Tanker Loads		Tankers Required	
	M46-M4	M46-T42	M46-M4	M46-T42
200	0.5	0.3	Less than 1	Less than 1
400	1.0	0.6	Less than 1	Less than 1
600	1.5	0.9	Less than 1	Less than 1
800	2.0	1.2	Less than 1	Less than 1
1000	2.5	1.5	One	Less than 1

For the rail movement from Pusan it is assumed that each tank car has a capacity of 8000 gallons of fuel and moves 30 miles per day.* Then the number of tank cars required to move the differences in fuel consumed is computed as:

$$\frac{2 \text{ x distance}}{30 \text{ miles per day}} \text{ or } \frac{2 \text{ x } 260}{30} = 17.6 \text{ days turn-around time.}$$

Thus, in six months each tank car makes:

* FM101-10

$$\frac{180}{17.6} = 10.2 \text{ trips.}$$

Table X shows the number of tank cars required.

TABLE X

TANK CARS REQUIRED TO SUPPLY FUEL DIFFERENCES FOR SIX MONTHS

Tank Miles Per Month	Tank Car Loads		Tank Cars Required	
	M46-M4	M46-T42	M46-M4	M46-T42
200	360	216	35	21
400	720	532	70	42
600	1080	748	106	64
800	1440	964	141	85
1000	1800	1180	176	106

It is assumed that the fuel will be barreled at the railhead in 55-gallon drums filled to 53 gallons. A $2\frac{1}{2}$-ton truck can move 14 barrels per trip* and can cover 100 miles in one day. Thus the number of trucks required is:

$$\frac{2 \text{ x distance}}{100 \text{ miles per day}} = \frac{100}{100} = 1 \text{ day turn-around time.}$$

In six months, each truck can make:

$$\frac{180}{1} = 180 \text{ trips}$$

and can move 180 x 14 or 2520 barrels in six months.

TABLE XI

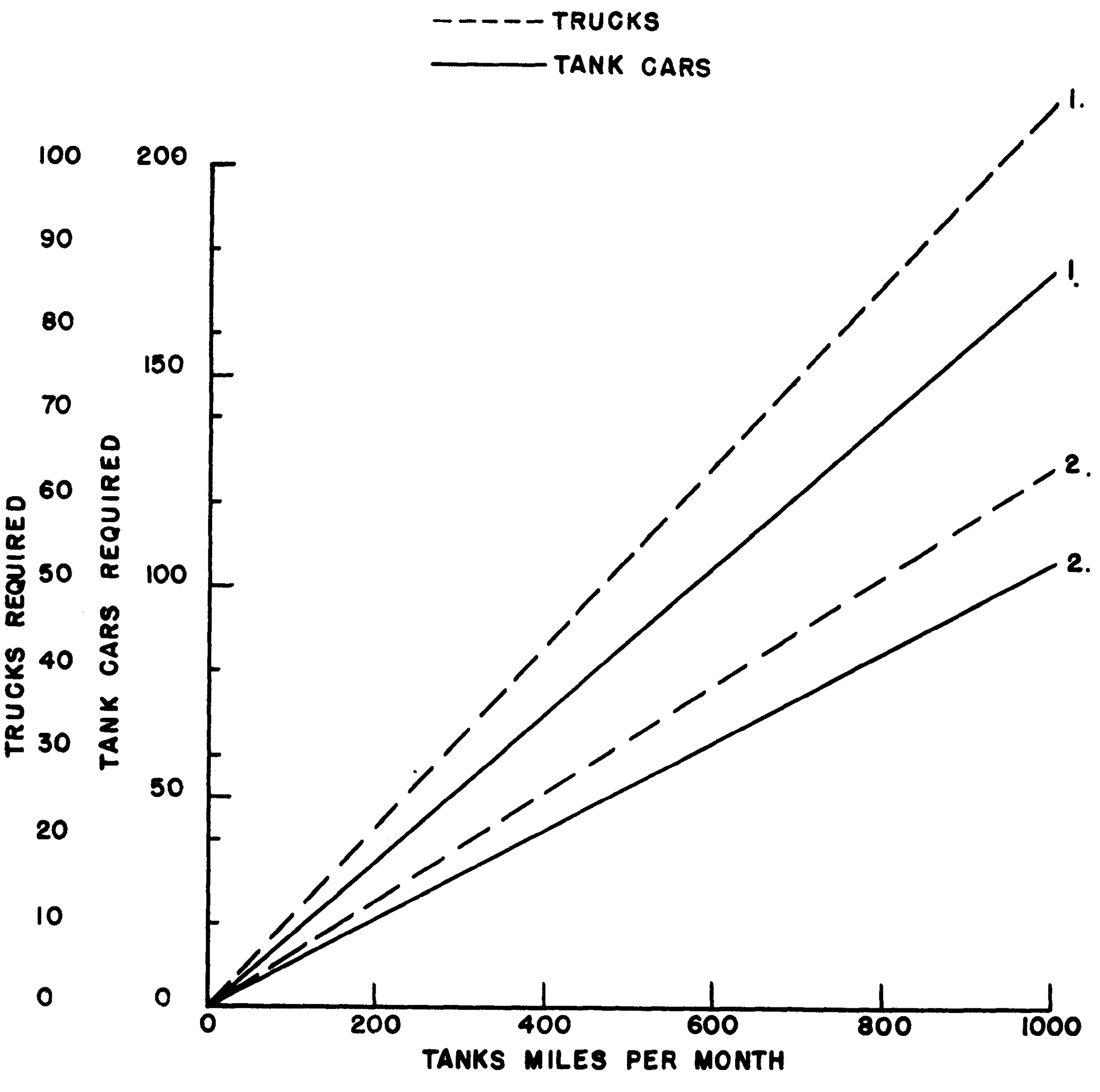
TRUCKS REQUIRED TO SUPPLY FUEL DIFFERENCES FOR SIX MONTHS

Tank Miles Per Month	Barrels of Fuel		Trucks Required	
	M46-M4	M46-T42	M46-M4	M46-T42
200	54,400	32,600	22	13
400	108,800	65,200	43	26
600	163,200	97,800	65	39
800	217,600	130,400	86	52
1000	272,000	163,000	108	65

It is of interest to show the number of F-80 sorties which could be flown on the fuel saved by using the M4A3 tank in place of the M46, and also on the fuel saved by using the T42 tanks in place of the M46 tanks. An F-80 uses approximately 800 gallons of fuel per sortie. Assuming an average of 1.5 sorties per day

* FM101-10.

FIG. 3 — (DATA FROM TABLES X AND XI)
RAIL TANK CARS AND 2 1/2 TON TRUCKS REQUIRED TO MOVE THE DIFFERENCE IN FUEL BETWEEN 1. THE M4A3 TANK AND THE M-46 TANK; AND 2. THE T-42 TANK AND THE M-46 TANK
VS.
TANK MILES PER MONTH
1200 TANKS IN KOREA — 6 MONTH PERIOD



per aircraft, in a six-month period one F-80 will then use 216,000 gallons of fuel. The saving in fuel by using the M4A3 tank in place of the M46, or the T42 in place of the M46, may now be converted into the number of F-80's that could be kept in operation on this amount of fuel, as shown in Table XII.

TABLE XII

NUMBER OF F-80'S OPERATED FROM FUEL SAVINGS

Tank Miles Per Month	Equivalent Number of F-80's Flying 1.5 Sorties Per Day	
	M46-M4	M46-T42
200	14	8
400	27	16
600	41	24
800	54	32
1000	68	40

3. Application to European Theater

On the basis of 10,000 tanks in Europe in the event of a war, the number of tankers, tanks, rail cars, and trucks required to move the difference in fuel consumed by the tanks can also be shown together with the F-80 sorties. The data are given in Table XIII. Since the distance from the east coast of the United States to Europe is shorter than the distance from the west coast to Korea, the tanker turn-around times are recomputed. It should be pointed out that the fuel consumptions of the tanks will probably be less in Europe than in Korea due to the difference in terrain; however, any such difference is not considered in the following table, the fuel consumptions being taken as those experienced in Korea.

TABLE XIII

EXCESS LOGISTICAL REQUIREMENTS OVER

SIX-MONTH PERIOD IN EUROPEAN THEATER

Tank Miles Per Month	Tankers		Tank Cars	
	M46-M4	M46-T42	M46-M4	M46-T42
200	1.3	0.8	294	177
400	2.6	1.6	588	354
600	4.0	2.4	882	531
800	5.3	3.2	1176	708
1000	6.6	4.0	1470	885

FIG 4.- THE NUMBER OF F-80 PLANES THAT CAN BE OPERATED ON THE DIFFERENCE IN FUEL BETWEEN
1. THE M4A3 TANK AND THE M-46 TANK; AND
2. THE T-42 TANK AND THE M-46 TANK
VS.
TANK MILES PER MONTH

(1200 TANKS IN KOREA - 6 MONTH PERIOD)
(DATA FROM TABLE XII)

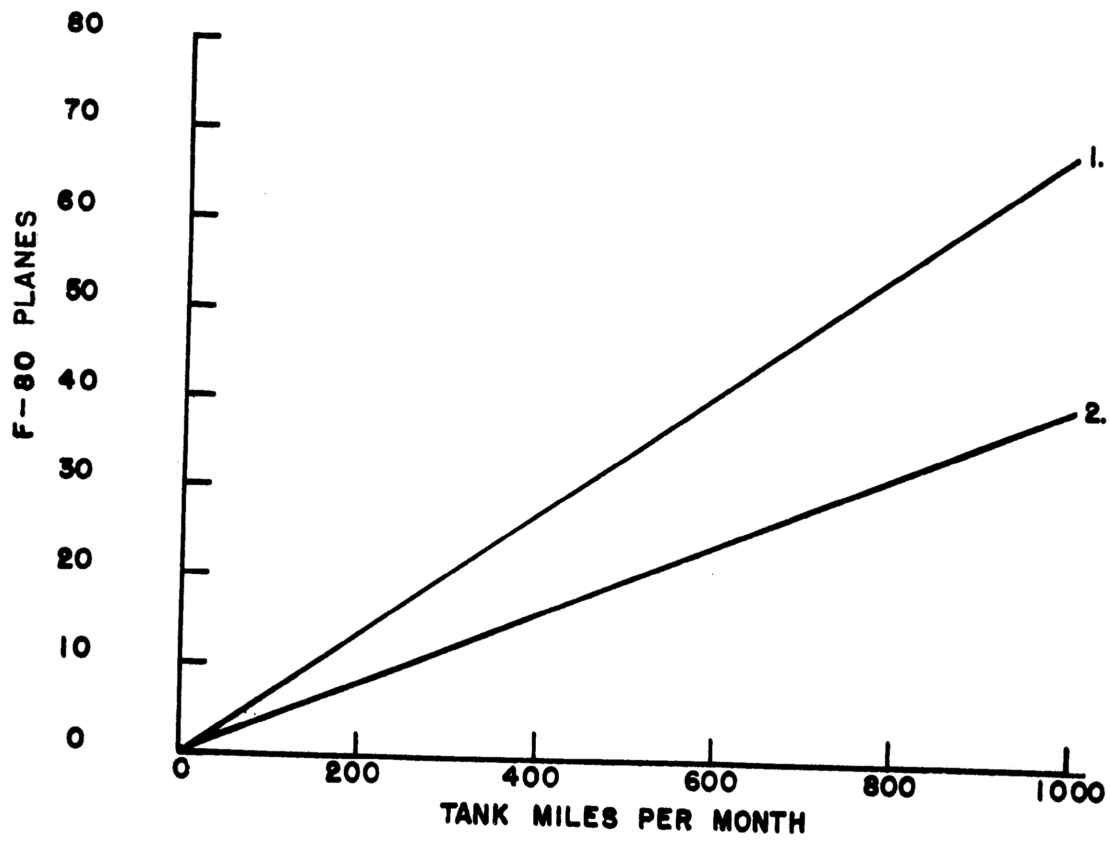


FIG. 5 – TANKERS, RAIL CARS AND 2 1/2 TON TRUCKS REQUIRED TO MOVE THE DIFFERENCE IN FUEL BETWEEN 1. THE M4A3 TANK AND THE M-46 TANK AND 2. THE T-42 TANK AND THE M-46 TANK. THE NUMBER OF F-80 PLANES WHICH CAN BE FLOWN ON THESE DIFFERENCES IN FUEL VS. TANK MILES PER MONTH.

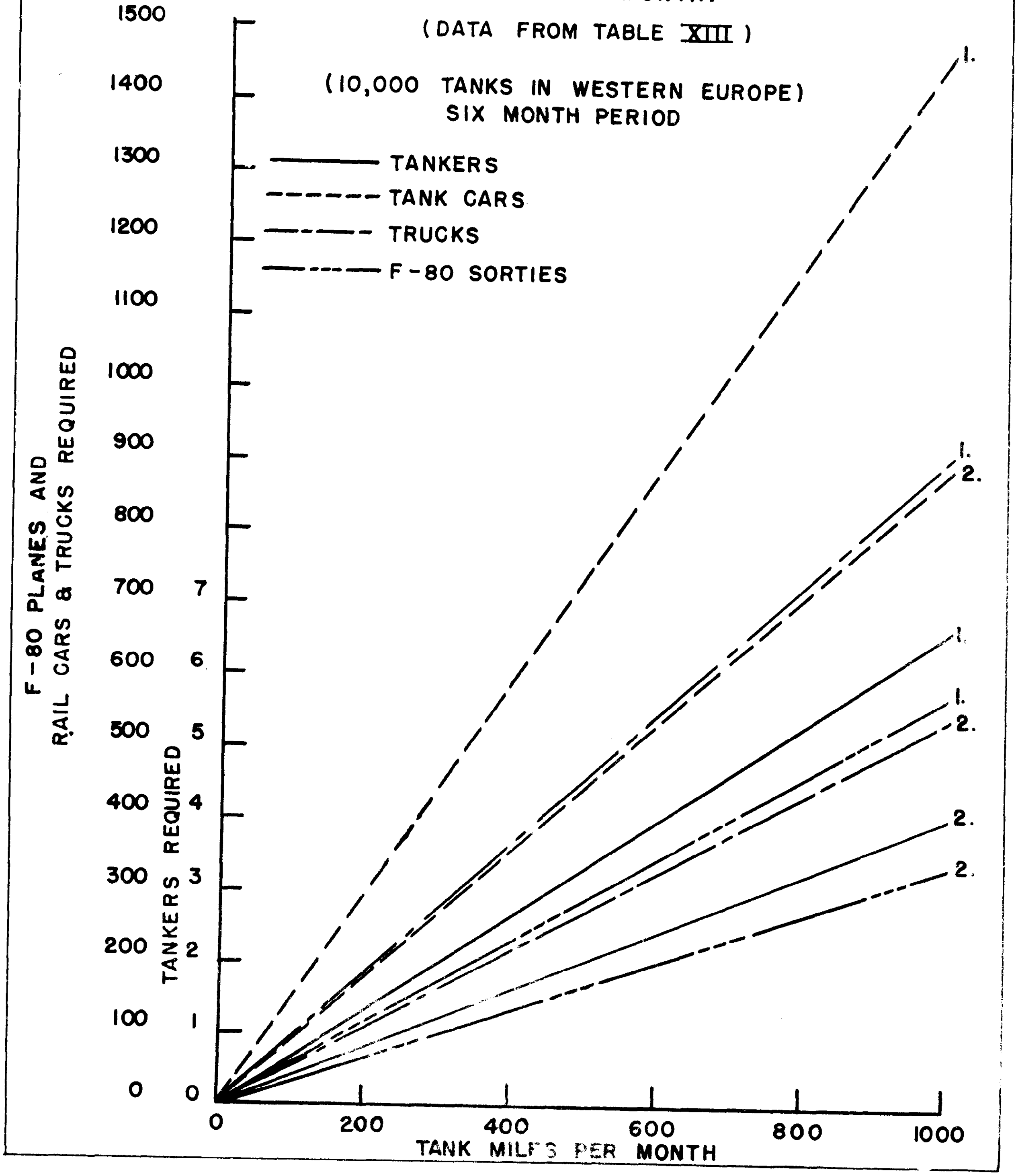


TABLE XIII (continued)

Tank Miles Per Month	Trucks		Equivalent No. of F-80's	
	M46-M4	M46-T42	M46-M4	M46-T42
200	180	108	114	67
400	360	216	228	134
600	540	324	342	201
800	720	432	456	268
1000	900	540	570	335

Thus, it can be seen that if 10,000 T42's were used instead of M46's over a six-month period in Europe, running the equivalent of 20 miles a day, the saving would amount to 2.4 tankers, 531 tank cars and 324 trucks. Although this would be only a small proportion of the total transport, any reduction in the number of vehicles would lead to a corresponding reduction in drivers, maintenance personnel, spare parts and shipping space required. In addition, the fuel saved would be sufficient to allow 200 F-80's to fly a daily 1.5 sorties over the six-month period. During wartime the saving of 13 tons of steel per tank, amounting to over half a million tons of steel saved if 40,000 T42's were built instead of M46's, would also be an important consideration.

CONCLUSIONS

Over-all the M4A3 has been twice as reliable mechanically as the M46 in Korea. It is recognized that the M46 will improve greatly in reliability as its early production weaknesses are eliminated.

The air-cooled engine of the M46 has been the most reliable tank engine.

The M46 transmission has had the least mechanical reliability among the tanks in Korea.

The reason for the high terrain loss of the M4A3 as compared to the M46 is undetermined, but may be due to:

1. Lower driver fatigue in the M46 because of hydraulic drive and control.

2. Greater mobility in the M46 owing to the higher power/weight ratio, hydraulic drive, and better tracks.

3. Use of the M4A3 in more dangerous terrain.

The high loss of tanks from mechanical failure was due mainly to their failure to stand up to sustained road marches during withdrawal. Almost all tanks could have been recovered and repaired during an advance or in a static combat situation.

CONCLUSIONS

The high gasoline consumption of the M46 as compared to the M4A3 is partly due to the excess weight of the M46, and partly to a thirty percent lower over-all efficiency. The cause of the lower efficiency in the M46 and T42 is believed, but not proved to be, the hydraulic drive.

The excess logistic requirements necessitated by the higher gasoline requirement of the M46 is an adverse factor in the use of this tank.

On the basis of 10,000 tanks running 600 miles per month in Europe, the use of the T42 in place of the M46 would save sufficient fuel for 300 daily F-80 sorties. If a T42 with a gear transmission instead of a hydraulic transmission was used, it is estimated that the saving would provide fuel for 500 daily F-80 sorties.

Not documented in this appendix, but demonstrated elsewhere in this report, is the substantially equal combat effectiveness of the M4A3 as compared with the M46 in Korea.

RECOMMENDATIONS

In view of the high incidence of mechanical failures, US tank designers should make a maximum effort by a research and development program to improve the mechanical reliability of tanks.

For production in the United States, the medium tank with the lowest possible weight for equivalent performance on the battlefield should be chosen. Since it is believed that the T42 could be equal or superior to the M46 on the battlefield, it should for the reason given previously supplant the M46 at the earliest possible moment.

A T42 with a gear transmission should be given serious consideration.

APPENDIX L

REPORT ON ARMOR FOR THE PERIOD
21 JANUARY TO 8 APRIL, 1951

by

E. D. Strong

INTRODUCTION

Previous sections of this document, ORO-R-1 (FEC), "The Employment of Armor in Korea", covered the use of armor by friendly and enemy forces from the outbreak of hostilities up to 21 January, 1951. This appendix, based on more recent visits to units in the field and discussions with I Corps and Eighth Army armor sections, is designed as a supplement to provide additional information on various aspects of armored warfare in Korea in the period 21 January-8 April.

During the period covered, all elements of the UN forces were engaged in what was officially described as an offensive with limited objectives, which led to the crossing of the Han and Pukhan rivers and the movement of UN forces to the vicinity of the 38th parallel. Enemy tactics indicated that they were trying to cause the maximum delay to the UN advance while building up for a counter-offensive from positions north of the 38th parallel.

With the exception of one T-34 which apparently was immobilized in a river bed, no enemy armor was encountered by UN ground forces. Friendly armor was employed in direct support of infantry attacks, on reconnaissance and patrol missions, and as tank-infantry task forces which penetrated into enemy-held areas to seek out his dispositions and cause maximum casualties and damage to troops and supplies. Armored columns also linked up with the 187th airborne RCT after their drop in the Munsan-ni area.

DISCUSSION

Tank Casualties

Friendly tank casualties during the period 21 January-8 April are given in Table I. Figures in parentheses denote tanks which were total losses or non-recoverable. The figure for tanks present on 1 April includes all tanks in the hands of units and field ordnance.

TANK CASUALTIES

TABLE I

TANK CASUALTIES (KILLS)
21 January-8 April 1951

Type of Tank

Casualty	M24	M4A3	M26	M46	M32	Centurion	Churchill	Total
Mech Failure	28(1)	92(2)	17(0)	55(1)	16(0)	9(0)	9(0)	226(4)
Mines	15(4)	58(13)	3(1)	12(1)	3(1)	--	--	91(20)
Bazooka	1(1)	3(3)	--	2(1)	--	--	--	6(5)
Mortar	--	2(0)	--	1(1)	--	--	--	3(1)
Pole Charges	--	2(0)	--	--	--	--	--	2(0)
Terrain	1(0)	15(6)	--	--	--	--	--	16(6)
Tactical Abandoned	--	3(3)	--	2(2)	--	--	--	5(5)
Accidental Causes	--	3(1)	--	--	--	--	--	3(1)
Number Present 1 April	65	449	96	191	46	61	18	926

Mechanical Failures

The number of mechanical failures, representing tanks evacuated to ordnance, cannot be considered excessive in view of the mileages that have been covered by many of the tanks, particularly M24's and M4A3's. Some of the original M4A3 tanks of the 70th and 89th tank battalions have covered about 2,500 miles in Korea, which is the normal life expectancy for this type of tank. On the other hand, about half the M46's in use are still in their first few hundred miles, and in view of this fact their mechanical efficiency cannot be considered satisfactory. The biggest cause of trouble is still with the transmission, oil-cooler fans, and fan towers, a problem that is being solved by redesign. A new trouble which has appeared in the 64th tank battalion is output-shaft failure on the final drive. It is thought that this may be caused by vibration resulting from the use of steel tracks on the high-crowned Korean roads, a view that is supported by the fact that the two battalions which have M46's with rubber-backed tracks have not experienced this trouble. As far as British tanks are

concerned, the Centurions, which have now completed some 700-800 miles of running, have performed satisfactorily with very little trouble with the engine or transmission. The main cause of difficulty has been broken quill shafts, all such damage occurring when starting or stopping the auxiliary generators and the tracks. There have been many instances of track throwing by the Centurions, and also many cases of retaining-pins coming out because of excessive wear on the head. The cause of this is not yet established though in one or two tanks the fact that the road wheels have not been perfectly aligned with the idler and sprocket may have been a contributory reason.

TABLE II

CAUSES OF MECHANICAL FAILURE BY TYPE

	M46	M26	M4A3	M24	M32
Engine	3	5	23	11	7
Transmission (incl gears, clutches)	8	2	14	5	4
Tracks, Final Drive Suspension	5	2	8	1	2
Cooling System (incl. Radiators)	1	2	3	-	-
Lubricating System (incl Oil Lines, Coolers)	21*	1	2	-	-
Engine Accessories (Aux Engines, Manifolds, Starters etc)	3	1	6	2	2
Gun and Recoil Mech	2	1	10	5	-
Turret Mechanism	-	-	2	2	-
Steering	3	1	6	2	1
Electrical System	5	-	3	-	-
Gas tanks	2	-	2	-	-
FWT	-	2	7	-	-
Unspecified	2	-	6	-	-
TOTAL	55	17	92	28	16

* 20 oil cooler fans.

Mines

All roads north of the Han River were found to be heavily mined, and coincident with the increase in the number of mines has been a vastly improved mining technique. Engineers of the 1st ROK division reported lifting 745 antitank mines in their section between the Han and Imjin Rivers, and in all sectors there was a considerable increase in enemy mining activity during

the period. Most of the antitank mines used have been Russian box-type mines and US M6's, but many makeshift mines have also been encountered including mortar and artillery shells tied together and emplaced with their fuses just above the ground.

Although most mines were buried just below the ground, a new technique has been noted by which mines are buried 18 to 24 inches below the surface. The result is a delayed activation caused by the steady tamping effect of several vehicles before the mines go off. These deep mines are difficult to detect.

The enemy has also used dummy holes with only scrap metal in them and scattered other scrap metal among his minefields in order to confuse detector teams. Booby-trapping of mines to hinder removal has been frequent.

Generally no set pattern was used, but rather a widespread haphazard sowing of mines wherever vehicles were likely to travel; this included laying mines underwater in river fords. Antitank mines have been used, on occasions, with two or more on top of each other, or reinforced with blocks of TNT. Although mine damage has been confined chiefly to tracks, road wheels, and suspensions, on occasions large charges have caused buckling or displacement of the hull; the latter effectively puts the tanks out of action by throwing the road wheels out of alignment and by internal damage usually accompanying such explosions. From multiple mines, approximately two personnel casualties occurred per tank, but in other cases personnel casulties were few and generally light. It is of interest to note that the first British mine casualty occured on April 14th. A Centurion hit a mine with the inside of the track which resulted in damage to the right front suspension and the two right front sets of road wheels, although the track remained unbroken, and no personnel casualties resulted.

Although most of the enemy mine fields had only attrition value, several were well covered by fire from infantry weapons and mortars and delayed the UN advance for periods of up to a day. On such occasions detecting and detonating devices on armored vehicles would have been of assistance; such devices would also be of value with tank-infantry task forces operating ahead of the main forces. At present, these task forces must either go slowly with detector teams out ahead, who are liable to be exposed to enemy fire, or else travel until a vehicle hits a mine and then sweep the remainder of the field. With frequent small mine fields containing just a few mines each, this can be a costly process. On the other hand sweeping every mile of road denies to armor its power of rapid movement and exploitation, and there have been instances in which, for the sake of speed, casualties have been accepted.

Antitank Weapons

The enemy appears to have relied on mines, tank traps, road blocks, and tank-killer squads to stop tanks. Antitank guns have been reported recently on only very few occasions. Frequently, tank-killer squads armed with bazookas, pole charges, or satchel charges attempt to ambush tanks at close quarters. Of the six tanks hit by bazookas, all believed to have been 3.5-inch, the range was in no case greater than 50 yards, and five tanks were penetrated, all in the sides and rear. Owing to tanks covering each other with their machine guns, or having infantry with them, close-quarter attack by enemy troops has been largely ineffective.

Light Aircraft

The value of light aircraft operating with tank battalions has been widely commented on. The following extract from the monthly "Report of Armor Section, I Corps" is of interest. "The light observation plane is a great asset for reconnoitering road nets and terrain over which friendly tanks must pass. It is so valuable that its loss, even temporarily, to a tank battalion can mean the difference between success and disaster. Divisions should never deprive tank battalions of the use of their assigned light aircraft except in cases of emergency . . . It is recommended that the T/O&E of a tank battalion be changed to include two liaison aircraft so as to provide adequate time for ground checks and maintenence and to insure uninterrupted air cover during an operation." It is felt that this recommendation is justified, and that two light aircraft should be provided for the British tanks operating with the 29th Brigade.

Indirect Fire

The majority of the tank battalions do not have their assault gun platoon (consisting of tanks equipped with 105-mm howitzers) and opinion is divided as to usefulness of this platoon. Nevertheless, several recent instances have occurred of tanks being used in indirect-fire roles for which the 105-mm howitzer would have been suitable. An extreme case was that of a platoon of B Company, 64th Tank Battalion, which fired 900 rounds of HE in four hours in support of the 24th RCT during their crossing of the Han River. One hour after the last round was fired the barrels were still too hot to touch, and two of the gun tubes needed replacement. (Although the normal life of a 90-mm gun tube can be considered as 1600 rounds, sustained firing of this kind will materially affect a gun's life.) Because tank guns and crews are not capable of the sustained rate of fire of field artillery, this kind of firing should only be resorted to in an emergency. However, tank-mounted howitzers, because of the greater lethal area of their shells and greater elevation of their guns, can give better indirect-fire support than high-velocity guns on

missions up to 12,000 yards range.

Special Vehicles

(1) Recovery Vehicles. As mentioned in earlier reports, tank-recovery vehicles have not proved adequate for the tasks imposed on them in Korea. This is because they are built on the chassis of obsolescent tanks and have not been powerful enough to handle larger and more modern tanks. Both in the case of the M32 and the Churchill ARV, the winch has proved adequate, but towing M46's and Centurions has proved too much of a strain. As a result, it is proposed to remove the turrets of three Centurions and use them for towing disabled tanks to the rear. Recovery vehicles built on the chassis of modern tanks, apart from having more power, would lessen the number of spare parts to be carried by the battalion; in the case of the M46 it would be desirable however to substitute a direct-drive low gear transmission in place of the torque converter for this type of work.

(2) Bridgelaying Tanks. The Churchill bridgelayer has found employment on several occasions recently, in one case acting as a bridge on the MSR south of Munsan-ni for fifteen hours while engineers were building a more permenent structure. On another occasion south of Wanjiwon-ni the enemy had blown a large crater in the road, making it impassable to vehicles in a place where adjacent hills and rice paddies made by-passing extremely difficult. The Churchill bridgelayer spanned the crater, and tanks and vehicles crossed within ten minutes of its arrival. The bridgelaying tank is a definite asset, but a 30-ft span on a more reliable chassis than the Churchill would be desirable. The slow speed of the Churchill bridgelayer is a handicap to the movement of armored columns.

(3) Flame-thrower Tanks. Targets for flame-thrower tanks have been very limited, and such tanks were only employed to any extent around the built-up areas of Yongdong-po and Seoul following the Inchon landing. The flame thrower is primarily a weapon of offense, but during the UN advance to the 38th parallel, enemy defensive positions tended to be situated on steep hillsides, and tanks seldom came within flame-thrower range of them. Air-dropped napalm was constantly used against such positions. The British squadron of Churchill flame-throwers have not been used in this role because of lack of opportunity, and all but one platoon are at present converted to gun tanks. It is considered unlikely that there will be much requirement for flame-throwing tanks in this campaign, although man-packed flame-throwers and air-dropped napalm will continue to be of great value against hillside positions.

(4) Armored Personnel Carrier. There is a requirement for a completely closed-in tracked vehicle, like the M44, which can give its occupants protection against small-arms fire and shrapnel,

and can traverse the same terrain as tanks. As an example, a tank-infantry task force with resupply vehicles attempted to relieve a surrounded RCT near Kapyong. The only approach was through a defile, and the enemy on the surrounding hills let the lead tanks through, but opened up with small-arms fire and bazookas on the rest of the column. Of a company of infantry riding the remaining tanks and in thin-skinned vehicles, only eight got through to the objective unwounded. A vehicle that was proof against small-arms fire would have prevented most of these casualties. Armored personnel carriers also would be useful in carrying stores and evacuating wounded over bullet-swept ground.

Ordnance Support

Units agree that ordnance support has greatly improved. Nevertheless the ordnance maintenance battalion in an infantry division cannot give sufficient support to a division that has a full complement of armor; the divisional tank battalion alone could utilize the full capabilities of the ordnance medium maintenance company. Difficulties could be reduced by having ordnance units closer to the front, thus cutting down on long road hauls of disabled vehicles, and by ordnance sending out more contact teams. It is uneconomical to have a recovery vehicle tow a tank back to ordnance for engine replacement when this job could be done by sending an engine and repair team from ordnance to the unit.

Spare-parts shortages still exist, the greatest shortage being in road wheels and heavy suspension assemblies to repair mine-damaged tanks. These parts are heavy and bulky, and ordnance units are limited in the number they can stock.

Supply

The farming out of tank companies in support of regiments has placed a considerable strain on the Headquarters and Service Companies of tank battalions, particularly if all companies are engaged in combat on the same day. An attempt is being made to estimate the average daily requirements of a tank company in combat. The largest requirement is POL, and preliminary findings indicate that this varies from 1500-1800 gallons for an M24 company to 3000-3500 gallons for an M46 company, representing two 2½-ton truck loads for an M24 company, and four for an M46 company. Fuel consumption at present is not as high as it was during the cold winter weather; on approach marches the M46 uses about 4 gal/mile (3.2 Imp gal) and the Centurion 3.5 gal/mile (2.8 Imp gal).

Ammunition expenditures have varied greatly according to the mission and the opposition, but tank companies have frequently used up to two 2½-ton truck loads of ammunition in a day, in addition to their own basic load. An increase in the strength of the POL and ammunition sections of the battalion supply platoon is

necessary to handle fuel and ammunition needs adequately.

British units have not experienced supply difficulties with tanks to date, as 29th Brigade has been using only one squadron of tanks at a time.

Combat Refuelling

It has been noticed that there is considerable variation in refuelling methods. Tank units draw fuel from supply points in 55-gallon drums. Some transfer gasoline to 5-gallon cans at battalion level, others at company level, and others refuel directly from the 55-gallon drums, either by means of hand pumps or by transferring the drums from the supply trucks to the tank decks. The majority of tank personnel prefer the 5-gallon containers, and consider the drums unwieldly because of their size and weight. There is however a shortage of 5-gallon containers in some units.

Bore Evacuators

Trouble with fumes in the fighting compartment causing distress among the crew after several rounds of rapid fire, mentioned in previous reports in connection with M26, has been almost completely solved by the bore evacuator in the M46. "A" Company of the 73rd tank battalion, which fired 707 rounds of 90 mm, 18,000 rounds of cal 0.30, and 6,000 rounds of cal 0.50 ammunition in support of a ROK raid across the Imjin River, stated that they had no trouble with fumes despite the fact that the tanks were "buttoned up" much of the time. British tank crews have however suffered from the effects of fumes in the fighting compartment, and a bore evacuator similar to that in the M46 would be valuable in removing this condition.

CONCLUSIONS

(1) The enemy's mine technique has improved. Russian box-type mines, US M6 antitank mines, and improvised mines have caused many tank casualties, most of which have, however, been repairable at battalion level.

(2) Mechanical failures are still many, but in view of the mileage run by most of the tanks, cannot be considered unreasonably high except in the case of the M46.

(3) Recovery vehicles capable of handling M46 and Centurion tanks are still a high-priority requirement.

(4) A requirement also exists for the following vehicles:

(a) A completely closed-in armored tracked vehicle for transporting troops and supplies;

(b) A bridgelayer tank;

(c) An armored mine-detonating or removing vehicle.

(5) Liaison aircraft have proved invaluable to tank battalions; it is considered that the T/O&E should provide two per battalion.

(6) Although ordnance support has improved, the scale of ordnance support is still insufficient to maintain all of the vehicles in an infantry division with its full complement of armor.

(7) The supply platoon of a tank battalion has insufficient personnel and vehicles to maintain all the companies in combat, particularly when they are operating separately with infantry regiments. The POL and ammunition sections in particular need strengthening.